Questions and Answers for Dental Students,

. . . BY . . .

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PART SECOND.—JUNIOR COURSE.

A SERIES

OF

Questions and Answers

FOR

DENTAL STUDENTS,

CONSISTING OF THREE PARTS:

PART I.—Pertaining to the Freshman Course.
PART II.—Pertaining to the Junior Course.
PART III.—Pertaining to the Senior Course.

PART II.

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Contents of Part II.

JUNIOR COURSE.

ANATOMY.

QUESTION. What are the nutritive fluids of the body.

ANSWER. Lymph, chyle, and blood.

Q. What is the nature of the *Blood.*

A. A thick opaque fluid; of a bright red color from the arteries, and dark red or purple from the veins; saltish to the taste, viscid and of a peculiar faint odor and an alkaline reaction.

Q. When allowed to stand after being drawn what is its appearance.

A. Soon solidifies into a jelly-like mass, after which drops of a transparent yellowish fluid ooze from the surface and collect around it.

Q. What occurs to this mass in about 24 hours.

A. It separates into two parts—clot or coagulum and serum.

Q. What is *Clot.*

A. It consists of a solid, colorless material, known as *fibrin*, and many minute cells or corpuscles, known as *blood-corpuscles.*

Q. When is the Fibrin formed.

A. During the act of solidification.

Q. What are the Blood-Corpuscles enclosed in.

A. In the fibrin, and thus the clot is formed.

Q. What is seen in a drop of blood by means of the microscope.

A. A number of minute bodies or corpuscles floating in a clear fluid.

Q. What two varieties of *corpuscles* does the blood hold in suspension.

A. The *red or colored* and the *white or colorless.*

Q. What is the clear fluid in which these corpuscles float called.

A. The *liquor sanguinis* or *plasma.*

Q. How does the liquor sanguinis differ from the serum.

A. It contains one at least of the elements from which fibrin is formed.

Q. Describe the *Red or Colored Corpuscles.*

A. Circular disks with a slight central concave depression having a raised border; of a faint reddish-yellow in arterial blood, and a greenish-yellow in venous blood; highly elastic.

Q. What is their size.

A. It varies, but their average diameter is 1-3200 of an inch, and their thickness 1-12000 of an inch.

Q. Describe the *White* or *Colorless Corpuscles.*

A. In human blood, larger than the red, rounder or spheroidal; they are a type of a true animal cell, and consist of a mass of transparent albuminous substance called *protoplasm*, containing one or more nuclei, and bright granules of a fatty nature; the white corpuscles are similar to those of lymph and chyle.

Q. What is the diameter of the *white corpuscles.*

A. 1-2000 to 1-2500 of an inch in diameter.

Q. What are *Blood-plaques* or *Blood-plates.*

A. A third corpuscle in the blood sometimes called haematoblasts; colorless

protoplasmic disks in the ratio of one to 18 or 20 red corpuscles, finely granular and without a nucleus.

Q. What do they bear an important relation to.

A. Coagulation of the blood, especially in the formation of thrombi.

Q. What is the *Liquor Sunguinis* or *Plasma*.

A. The fluid part of the blood composed of serum and fibrin elements which unite when out of the body and form the fibrin in connection with a fibrin ferment.

Q. What are the two *Fibrin Elements*.

A. *Fibrinogen* and *Fibrino-plastin* or *Paraglobulin*.

Q. What is the appearance of *Fibrin* when fresh blood is filtered.

A. A white or buff-colored substance of a stringy appearance.

Q. What is *Serum*.

A. The fluid liquor sanguinis after the fibrin elements have separated from it; straw-colored, with an alkaline reaction; it contains salts, fatty-matters, sugar, and gases.

Q. What are the Gases of the Blood.

A. Carbonic acid, oxygen, and nitrogen.

Q. What are *Blood Crystals*.

A. Haemoglobin separated from the blood undergoing crystallization called *haemoglobin crystals*; elongated prisms.

Q. What is *Lymph*.

A. A transparent, colorless, or slightly yellow watery fluid, conveyed by a system of vessels, called *lymphatics*, into the blood.

Q. What is *Chyle*.

A. An opaque, milky white fluid, absorbed by the villi of the small intestines from the food and carried by vessels called *lacteals* to the beginning of the thoracic duct, where it mixes with the lymph and is carried into the circulation by the same channels.

Q. What is *Connective Tissue*.

A. Tissues which support and connect the principal tissues of the body.

Q. Into what three groups are Connective Tissues divided.

A, Into *Fibrous Connective Tissues*, *Cartilage*, and *Bone*.

Q. What three forms of Fibrous Connective Tissue.

A. White, Yellow Elastic, and Areolar.

Q. What is *White Fibrous Tissue*.

A. It binds bones together in form of *Ligaments*; it connects muscles to bones or other structures in form of *Tendons*; and invests or protects various organs in form of Membranes.

Q. What is the nature of *Yellow Elastic Tissue*.

A. Elastic to such a degree that the white fibrous element is excluded; found in the vocal cords, trachea and bronchi, coats of blood vessels, and in certain ligaments.

Q. What is *Areolar Tissue*.

A. Tissue in which the meshes are easily distended, and thus separated into areolae or spaces, which communicate freely and are easily permeated by fluid, or inflated by air.

Q. What is *Adipose Tissue*.

A. Areolar Tissue whose areolae or spaces are occupied by fat-cells.

Q. What is *Cartilage*.

A. A non-vascular structure found in joints, thorax, air-passages, nostrils, ears, etc.

Q. What is cartilage which is afterwards replaced by bone, called.

A. Temporary Cartilage, which in the foetus, forms the greater part of the skeleton.

Q. What is the nature of Cartilage.

A. A gristly mass of firm consistence, elastic, and of a pearly-bluish color.

Q. What is the Color of *Bone* in its fresh state.

A. Pinkish-white externally and deep red within.

Q. Of what two kinds of tissue is Bone composed.

A. Dense and compact on exterior of the bone, and cancellous on the interior.

Q. What is the nature of the *Compact Tissue.*

A. Like ivory, but extremely porous.

Q. What is the nature of the *Cancellous Tissue.*

A. Consists of slender fibres and lamellae which unite to form a reticular structure, which resembles lattice-work.

Q. What is the difference in structure between the Compact and Cancellous Tissues.

A. The different amount of solid matter and the size and number of spaces in each.

Q. How do the nutrient vessels reach bone tissue.

A. By means of the fibrous membrane in which bone is enclosed called the periosteum.

Q. What occupies the interior of the bones of the limbs.

A. The *Marrow*, of a yellow color, consisting of fat, fluid, areolar tissue and vessels.

Q. What lines the interior of the cylindrical cavities of bone.

A. Medullary membrane, or Internal Periosteum.

Q. What is the relation of the periosteum to bone.

A. Adheres to surface of the bones in nearly every part, except at their cartilaginous extremities; it forms part of the strong ligaments or tendons attached to bone.

Q. Describe the *Periosteum.*

A. Consists of two layers closely joined, the outer formed of connective tissue with a few fat cells; the inner of elastic fibres, forming dense membranous networks; in the young it is very vascular and thick; in the old, thinner and less vascular.

Q. What is the source of the blood-vessels of the compact tissue of bone.

A. From the periosteum, the vessels passing into the minute orifices of this tissue and running through the Haversian Canals.

Q. How is the Cancellous Tissue supplied with blood-vessels.

A. In a like manner, but by a less number; the medullary canal is supplied by one large artery which enters at the nutrient foramen.

Q. What are the *Haversian Canals.*

A. Tubes which run parallel with the longitudinal axis of the bone for a short distance, and then branch and communicate.

Q. What is their diameter.

A. Average 1-500; some as large as 1-200 of an inch.

Q. What are *Lamellae.*

A. Thin plates of bone tissue encircling the central canal.

Q. What are *Lacunae.*

A. They appear like dark, oblong, opaque spots; but are cells filled during life with a nucleated cell, the processes from which pass down the canaliculi; and by means of these cells the nutritive fluids are brought into contact with the ultimate tissue of bone.

Q. What are *Canaliculi.*

A. Very minute canals which cross the lamellae and connect the lacunae with the adjoining lacunae and the Haversian Canal.

Compare the Analyses of Bone, Dentine, Enamel and Cementum.

	Bone.	*Dentine.*	*Enamel*	*Cementum.*
Calcium carbonate - -	7.05	3.36	4.37	8.02
Calcium phosphate - -	58.39 }	66.72	89.82	60.73
Calcium fluoride - -	2.25 }			
Magnesium phosphate - -	2.08	1.18	1.34	1.00
Organic Matter - -	30.23	28.01	3.59	29.42
Salts - - - - - - - - -				83

Q. The Organic and Inorganic constituents of Bone form what per cent.

A. Organic—one third, or 33.3 per cent.
Inorganic—two thirds, or 66.7 per cent

Q. What is the difference in proportion between the two constituents at different periods of life.

A. In the young the animal matter is in excess; in the old the bones contain more earthy and less animal matter.

Q. What are the *Muscles* formed of.

A. Bundles of reddish fibres called *fasciculi* endowed with the property of contractility, the bundles are enclosed in a delicate web called the *internal perimysium*, while the sheath which invests the entire muscle is called the *external perimysium.*

Q. What is the *Sarcolemma.*

A. The tubular sheath of the musuclar fibre; transparent, elastic, homogeneous membrane, very tough.

Q. What is the form and size of the Muscular Fibres.

A. Cylindrical or prismatic, not very long—1½ inch, their average breadth being 1-400 of an inch.

Q. What is the function of *Gray or Vesicular Nervous Structure or Substance.*

A. To originate nervous impressions and impulses.

Q. What is the function of *White or Fibrous Nervous Structure.*

A. To conduct nervous impressions and impulses.

Q. How is the Gray Structure distinguished.

A. By its dark reddish-gray color and soft consistence.

Q. What is it composed of.

A. Of vesicles or corpuscles—nerve or ganglion corpuscles, containing nuclei and nucleoli.

Q. What is the *White* or Fibrous Structure composed of.

A. Two kinds of fibres—the medullated or white, and the non-medullated or gray fibres.

Q. Where is the Gray or Vesicular Structure found.

A. Brain, Spinal cord, various ganglion, in some of the nerves of special sense, and in gangli form enlargements in the course of certain cerebro-spinal nerves.

Q. Where is the White or Fibrous Structure found.

A. In the nervous cords, a great part of the brain, and spinal cord.

Q. What do the Medullated or Dark-bordered fibres form.

A. The white part of brain and spinal cord, and greater part of the cerebro-spinal nerves, and give to these structures their opaque white appearance.

Q. What do they present when examined.

A. Two parts; the central portion is called the *Axis-Cylinder*, and around this is a sheath of fatty matter called the *White Substance of Schwann*, the whole being enclosed in a delicate membrane called the *Neurilemma or Primitive Sheath*.

Q. How much of the nerve-tube does the axis-cylinder constitute.

A. One-half or one-third.

Q. What is the function of the Medullary Sheath or White Substance of Schwann.

A. Fatty matter in a fluid state which insulates and protects the essential part of the nerve—the axis-cylinder.

Q. What is the size of the nerve-fibres of the White Substance.

A. 1-1200 to 1-2000 of an inch.

Q. What is the *Brain or Eucephalon.*

A. That part of the cerebro-spinal system which is contained in the cavity of the skull.

Q. Into what parts is it divided.

A. Medulla oblongata, pons, cerebellum, and cerebrum.

Q. What is the *Neuroglia.*

A. A network of fine connective tissue which supports the brain and spinal cord.

Q. What are the nerves connected with.

A. At one end with the cerebro-spinal centre or with the ganglia, and distributed at the other end to the different textures of the body.

Q. What is a *Nerve Plexus.*

A. The communications which take place between two or more nerves.

Q. What is the course of Nerves.

A. They subdivide into branches, and these frequently communicate with branches of a neighboring nerve.

Q. How are the *Sympathetic Nerves* constructed and of what do they consist.

A. Like the cerebro-spinal nerves, and consist mainly of non-medullated fibres collected into funiculi and enclosed in a sheath of connective tsssue.

Q. What do the *Sensory* or *Afferent Nerves* transmit.

A. Impressions made upon the peripheral extremities to the nerves.

Q. What do the *Motor* or *Efferent Nerves* transmit.

A. Impressions from the nervous centres to the parts where the nerves are distributed.

Q. How may the *Ganglia* be regarded.

A. As separate and independent nervous centres, smaller than the brain, and of less complex structure, connected with each other, with the cerebro-spinal axis, and with the nerves in different situations.

Q. What do *Ganglia* consist of.

A. Vesicular nervous matter traversed by tubular and gelatinous nerve-fibres.

Q. What does the *Vascular System* comprise.

A. The Heart, Arteries, Veins, Capillaries, and Lymphatics.

Q. What is the structure of the *Inner* or *Endothelial* coat of an Artery.

A. Consists of a layer of pavement epithelium, a subepithelial layer of delicate connective tissue with branched cells in the inter-spaces, and an elastic layer consisting of an elastic membrane with a network of elastic fibres which forms the chief thickness of the inner coat.

Q. What distinguishes the *Middle* coat of an Artery from the Inner coat.

A. Its color, and the transverse (circular) arrangement of its fibres.

Q. What does the Middle Coat consist of.

A. Two elements, elastic and muscular, the elastic being in excess in the larger arteries.

Q. How is a continuous blood-current kept up.

A. The arteries are distended with blood forced into them by the systole of of the heart, and by their gradual contraction during the diastole, keep up a continous current.

Q. What is the function of the muscular element of the Middle coat.

A. By its contraction and relaxation, it regulates the quantity of blood sent to any part.

Q. What does the *External* coat of an Artery consist of.

A. Mainly of connective tissue and elastic fibres; in large arteries it is thin, but in small it is as thick as the middle coat.

Q. Are arteries supplied with vessels and nerves.

A. Yes, the vessels being called *vasa vasorum*—vessels of vessels; the nerves are chiefly from the sympathetic, and partly from the cerebro-spinal system.

Q. What is the usual size of the Capillaries.

A. 1-3000 of an inch in diameter; in skin and marrow 1-1200.

Q. Where are the Capillaries located.

A. Between the smallest branches of the arteries and the commencing veins.

Q. Are the Veins constructed like the arteries.

A. Yes, they have three coats analogous to those of the arteries.

Q. What is the principal difference between the coats of the veins and arteries.

A. The weakness of the middle coat of the veins, which allows them to collapse when divided and not stand open like the arteries.

Q. What purpose do the valves of the veins serve.

A. Prevent the reflux of the blood.

Q. Are the veins supplied with nutrient vessels and nerves like the arteries.

A. Yes, but the nerves are less in number.

Q. What is the structure of the *Lymphatics and Lacteals.*

A. Composed of three coats—internal or elastic, external, or fibro—areolar and the middle, or muscular.

Q. What is the function of the *Lymphatics.*

A. To carry off most of the waste products, and to act as absorbents.

Q. What is the function of the *Lacteals.*

A. To take up the chyle.

Q. What is the nature of *Mucous Membranes.*

A. Soft, velvety, very vascular, surface coated with a tenacious secretion called *mucus*, which protects such membranes from foreign substances.

Q. What is the epithelial layer of Mucous Membrane supported by.

A. The Corium, analogous to the derma of the skin.

Q. What is the Nature of the *Corium.*

A. Very vascular, with a dense network of capillaries which lie immediately beneath the epithelium and are derived from small arteries of the submucous tissue.

Q. What are found imbedded in Mucous Membrane.

A. Numerous glands.

Q. What project from its surface.

A. Villi and papillae, processes analogous to the papillae of the skin.

Q. What two tracts does Mucous Membrane cover.

A. The Gastro-pulmonary and the Genito-urinary.

Q. Describe the extent of the *Oral Mucous Membrane.*

A. For upper jaw, it begins at upper lip and is reflected to upper jaw and at the central incisors it forms fraenum of upper lip ; then passes over alveolar ridge to roof of mouth which it covers, and extends as far back as posterior edge of palate bones ; it is then reflected downwards covering the soft palate ; then it passes upwards lining the nares and downwards lining pharynx, aesophagus, stomach and intestines ; after entering nostrils and lining floor, roof and septum of nose, and turbinated bones, it enters the maxillary sinus or antrum and lines that cavity. In lower jaw, it lines posterior surface of lower lip ; thence reflected on anterior face of lower jaw where it forms the fraenum of lower lip ; then over alveolar ridge covering it in front and passes over its posterior surface where it enters mouth proper; then reflected to under surface of tongue where it forms its fraenum ; then spreads over dorsum and sides of tongue to its root ; then reflected to epiglottis forming another fold ; then enters glottis, and lines larynx, trachea, etc.

Q. Where are the Temporal Bones situated.

A. At side and base of the skull.

Q. Of what three parts does each of the Temporal Bone consist.

A. Squamous, mastoid and petrous.

Q. What is the *Squamous* portion.

A. The upper and anterior part of the bone.

Q. What is its form, etc.

A. Scale-like, thin, translucent, outer surface smooth, convex, and grooved at back part for deep temporal muscles.

Q. What muscle does it afford attachment for.

A. Temporal Muscle.

Q. What fossa does this Squamous portion form a part of.

A. Temporal fossa.

Q. What fascia does the curved temporal ridge at its back part give attachment to.

A. Temporal fascia.

Q. What more does this temporal ridge do.

A. Limits origin of temporal muscle, and marks line between the Squamous and Mastoid portions.

Q. What is the Zygoma or Zygomatic Process.

A. A long arched process projecting from lower part of squamous portion.

Q. How is the Zygoma connected to the Temporal Bone.

A. By anterior, middle, and posterior roots.

Q. What does the anterior root terminate in.

A. A rounded eminence called Eminentia Articularis.

Q. What does the Eminentia Articularis form.

A. The front boundary of the Glenoid Cavity.

Q. What does the Middle Root form.

A. Outer margin of Glenoid Cavity.

Q. Where does it end.

A. At Glasserian Fissure.

Q. Where is the Tubercle for the attachment of the External Lateral Ligament of Lower Jaw.

A. At the junction of anterior root with Zygoma.

Q. Where is the oval depression forming a part of glenoid fossa for condyle of lower jaw.

A. Between anterior and middle roots.

Q. What is the nature of internal surface of Squamous Portion.

A. Concave, with many eminences and depressions for the cerebrum.

Q. How is the Glenoid Fossa bounded.

A. In front by eminentia articularis; behind by vaginal process; externally by auditory process, and middle root of Zygoma.

Q. What is the Glasserian Fissure.

A. A narrow slit which divides the Glenoid fossa into two parts.

Q. What forms the posterior part of this fossa.

A. The Tympanic Plate, a lamina of bone which forms anterior wall of tympanum and external auditory meatus.

Q What does the Tympanic plate form at its lower part.

A. A sharp edge called the Vaginal Process.

Q. A part of what gland does the Tympanic Plate lodge.

A. Parotid Gland.

Q. Where is the *Mastoid Portion* of Temporal Bone situated.

A. At posterior part of bone.

Q. What is the nature of its outer surface.

A. Rough, and perforated by numerous foramina.

Q. Where is one of these of large size called the Mastoid Foramen.

A. At posterior border of bone, and transmits vein to lateral sinus, and artery to dura mater.

Q. What is the Mastoid Process.

A. A conical projection of the Mastoid portion downward.

Q. What is the *Digastric Fossa.*

A. A deep groove on inner side of Mastoid process for attachment of digastric muscle.

Q. Where is the Occipital Groove.

A. Parallel (but more internal) with the digastric fossa.

Q. What does it lodge.

A. Occipital artery.

Q. Where is the *Fossa Sigmoidea.*

A. A deep curved groove on internal surface of Mastoid Process, for part of lateral sinus.

Q. What are the *Mastoid* cells.

A. A number of cellular spaces hollowed out in Mastoid Process.

Q. Where is the Petrous Portion of Temporal Bone situated.

A. Wedged in at base of skull between sphenoid and occipital bones.

Q. What is its form, and direction.

A. Pyramidal; direction from without being inward, forward and slightly downward.

Q. What parts compose it.

A. Base, apex, three surfaces, and three borders.

Q. What does the Petrous Portion contain in its interior.

A. The essential parts of the ear.

Q. What is the Meatus Auditorius Externus.

A. A canal leading into the tympanum of ear.

Q. Where is this canal situated.

A. In front of the mastoid process and between the posterior and middle roots of the Zygoma.

Q. What is the Auditory Process.

A. A curved plate which surrounds part of circumference of Auditory canal.

Q. What is the nature of Apex of Petrous Portion.

A. Rough and uneven.

Q. What is it received into.

A The angular interval between posterior border of greater wing of sphenoid bone and basilar process of occipital.

Q. What does the anterior surface of Petrous Portion form.

A. Posterior part of middle fossa of skull.

Q. What does the Posterior surface form.

A. Front part of posterior fossa of skull.

Q. What does the Inferior or Basilar surface form.

A. Part of base of skull.

Q. What are the Borders of the Petrous Portion.

A. Superior, Posterior, and Anterior.

Q. What deep excavation is in the outer half of Posterior Border.

A. Jugular fossa.

Q. Where is the *Sphenoid Bone* situated.

A. At the Anterior part of base of skull.

Q. What does it articulate with.

A. All of the other bones of the cranium which it binds together.

Q. How is it divided.

A. Into a central portion or body, two greater and two lesser wings, and two processes below—pterygoid.

Q. What is the Body of this bone.

A. Large, cuboid in form, hollowed out inside, forming a mere shell.

Q. Describe the Body.

A. Consists of four surfaces—superior, inferior, anterior, and posterior.

Q. What is the Ethmoidal Spine.

A. A prominent point in front of superior surface for articulation with ethmoid bone.

Q. What is the Optic Groove.

A. A narrow transverse groove on Superior surface for the optic commissure.

Q. What is the Optic Foramen.

A. Termination of Optic Groove, for passage of optic nerve and ophthalmic artery.

Q. What is the Olivary Process.

A. A small eminence, of olive shape, behind optic groove.

Q. What is the Pituitary Fossa or Sella Turcica.

A. A deep depression posterior to optic groove for the pituitary body.

Q. What are the Middle Clinoid Processes.

A. Two small eminences which bound the Pituitary Fossa in front.

Q. What is the Carotid or Cavernous Groove.

A. A broad groove on either side of the body which lodges the internal carotid artery.

Q. Describe the Posterior Surface.

A. Quadrilateral in form, and joined to the basilar process of occipital bone.

Q. What is the Ethmoidal Crest.

A, A vertical lamella in the middle line of anterior surface, which articulates in front with ethmoid bone, and forms part of septum of nose.

Q. What are the Sphenoidal Cells or Sinuses.

A. Two large irregular cavities hollowed out of interior of body of the Sphenoid bone, partly closed in front by the Sphenoidal turbinated bones, having a round opening by which they communicate with the nose.

Q. What is the Rostrum.

A. A triangular spine in middle line of inferior surface, which is received into a deep fissure between the alae of the vomer.

Q. What is the Pterygo-palatine canal.

A. A canal close to the root of pterygoid process, for the pterygo-palatine vessels and pharyngeal nerve.

Q. What are the Greater Wings.

A. Two strong processes arising from sides of body of bone, curved upward outward and backward, prolonged behind into a sharp-pointed extremity called the Spinous Process, each has three surfaces and a circumference.

Q. What does the Superior or Cerebral Surface form.

A. Part of the middle fossa of skull.

Q. Where is the Foramen Rotundum.

A. At the anterior and internal part of the Superior Surface ; it transmits the second division of 5th Pair of Nerves.

Q. Where is the Foramen Ovale.

A. Behind and external to the foramen rotundum for transmission of 3d division of 5th Pair of Nerves.

Q. Where is the Foramen Vesalii.

A. At inner side of foramen ovale, opposite root of pterygoid proces, transmits a small vein.

Q. Where is the Foramen Spinosum.

A. In posterior angle near spine of sphenoid ; it transmits middle meningeal artery.

Q. What does the Pterygoid Ridge divide.

A. The convex External Surface of the greater wing into two portions.

Q. Where is the External Pterygoid muscle attached.

A. To the inferior portion of the external surface.

Q. Where is the Temporal Muscle attached.

A. To the superior portion of the external surface.

Q. Where is the Spinous Process of Greater Wing.

A. At posterior part of Inferior portion External Surface.

Q. What are connected to Spinons Frocess.

A. Internal lateral ligament of lower jaw and tensor palati muscle.

Q. What does the smooth quadrilateral Anterior Orbital Surface of Greater wing form.

A. Outer wall of orbit of the eye.

Q. With what does the outer half of the margin of the serrated circumference of the Greater Wing articulate

A. Petrous portion of Temporal Bone.

Q. What does the inner half form.

A. Anterior boundary of foramen lacerum medium, and presents posterior aperture of Vidian canal.

Q. Where does the circumference of Greater Wing articulate with Squamous portion of Temporal Bone.

A. The serrated edge in front of Spine.

Q. Where does the Greater Wing articulate with Parietal Bone.

A. At tip, in a triangular portion.

Q. Where with the Frontal Bone.

A. At a broad serrated surface internal to the triangular portion.

Q. What are the *Lesser Wings*.

A. Two thin triangular plates of bone arising from upper and lateral parts of body of Sphenoid; they project outward terminating in a sharp point.

Q. What does the smooth, flat superior surface of each support.

A. The anterior lobe of brain.

Q. What does the inferior surface form.

A. The back part of roof of orbit of eye, and foramen lacerum anterius.

Q. Where does this triangular fissure lead.

A. From cavity of cranium into orbit.

Q. Converted into a foramen by articulation with frontal, what does this fissure transmit.

A. The 3d, 4th, 1st division of 5th and 6th nerves, filaments of cavernous plexus of sympathetic, orbital branch of middle meningeal artery, a branch of lachrymal artery to dura mater, and opthalmic vein.

Q. What does anterior border of Lesser Wing articulate with.

A. Frontal Bone.

Q. Into what is the Posterior Border received.

A. Into Fissure of Silvius of brain.

Q. What does the inner extremity of Posterior Border form.

A. Anterior Clinoid Process.

Q. Where is the Optic Foramen.

A. Between the two roots for transmission of optic nerve and ophthalmic artery.

Q. Where are the Pterygoid Processes of Sphenoid Bone.

A. One on each side descend from point where body and greater wing unite.

Q. What does each of these Processes consist of.

A. An External and Internal Plate.

Q. What separates the plates behind.

A. An intervening notch known as the Pterygoid Fossa.

Q. What does the broad, thin External Pterygoid Plate form.

A. Part of inner wall of Zygomatic fossa.

Q. What does it give attachment to by its outer surface.

A. External Pterygoid Muscle.

Q. What is the Hamular Process.

A. The hook-like extremity of the long and narrow Internal Pterygoid Plate.

Q. Where is the Scaphoid Fossa.

A. At base of Internal Pterygoid Plate.

Q. What does the anterior wall of Pterygoid Process form.

A. Posterior wall of Spheno-Maxillary Fossa ; it supports Meckel's Ganglion.

Q. What are the *Sphenoidal Turbinated* or *Spongy Bones.*

A. Two thin curved plates of bone which are separate until puberty and sometimes are never joined to Sphenoid bone.

Q. What does each one articulate with.

A. In front with Ethmoid ; externally with Palate bones.

Q. With what bones does the Sphenoid articulate.

A. With all of the cranium, five of face—2 malar, 2 palate, and vomer ; it also sometimes articulates with Superior Maxilla.

Q. What is the nature of the *Ethmoid Bone.*

A. Very light and spongy, cubical in form.

Q. Where is it situated.

A. At anterior part of base of cranium, between the two orbits at root of nose, helping to form each of these cavities.

Q. Of how many parts does it consist.

A. Three, a horizontal plate forming part of base of cranium ; a perpendicular plate, forming part of septum of nose ; and two lateral masses of cells.

Q. Where is the thick, smooth triangular process called *Crista Galli.*

A. It projects upward from the middle line of the horizontal or cribriform plate.

Q. What does the cribriform plate on each side of crista galli support.

A. Bulb of olfactory nerve.

Q. What does the Perpendicular Plate assist in forming.

A. Septum of nose.

Q. What does the anterior border of this Plate articulate with.

A. Nasal spine of frontal and crest of nasal bones.

Q. What is its posterior border divided into two parts, connected with.

A. By its upper half with Sphenoid, and its lower half with Vomer.

Q. What is attached to its Inferior border.

A. Triangular Cartilage of nose.

Q. What are the *Lateral Masses of Ethmoid Bone.*

A. The Ethmoidal Cells, a number of thin walled cavities, placed between two vertical plates, the outer forming part of orbit, the inner one part of nasal fossa of same side.

Q. What are the *Ethmoidal Foramina.*

A. Anterior and Posterior openings into orbit.

Q. What is the Os Planum.

A. A thin smooth square plate of bone which forms the outer surface of each lateral mass.

Q. What is the Unciform Process.

A. An irregular lamina which projects from inferior part of each lateral mass, immediately beneath the os planum.

Q. What does it serve to close.

A. The upper part of orifice of antrum.

Q. What does the inner surface of each lateral mass form.

A. Part of outer wall of nasal fossa of same side.

Q. What does the inner surface terminate in as it descends from under surface of cribriform plate.

A. The Middle Turbinated Bone.

Q. What is the Superior Turbinated Bone.

A. A thin curved plate which bounds above the superior meatus of nose.

Q. Where is the Middle Turbinated Bone.

A. Below and in front of Superior Meatus, extending whole length of inner surface of each lateral mass.

Q. What is the Infundibulum.

A. A funnel-shaped canal by means of which the anterior ethmoidal cells, and through them the frontal sinuses communicate with the nose.

Q. With what 15 bones does the Ethmoid articulate.

A. Sphenoid, 2 sphenoidal turbinated, frontal, 2 nasal, 2 superior maxillary, 2 lachrymal, 2 palate, 2 inferior turbinated, and vomer.

Q. What are the *Nasal Bones.*

A. Two small oblong bones placed side by side at middle and upper part of face.

Q. What do they form by their function.

A. The Bridge of Nose.

Q. Describe the Nasal Bones.

A. Each has two surfaces, outer and inner, and four borders; the outer surface is concave from above downward, convex from side to side, the inner surface is concave from side to side, convex from above downward; the superior border is thick and articulates with frontal; the inferior border is broad, thin and sharp, directed obliquely outward, downward, and backward, to which is attached the lateral cartilage of nose.

Q. What is the Nasal Angle.

A. The border prolonged at its inner extremity into a sharp spine.

Q. What does the external border of Nasal bone articulate with.

A. Nasal process of Superior Maxillary.

Q. What does the internal border articulate with and form.

A. Its fellow of opposite side, and forms part of septum of nose, being prolonged behind into a vertical crest.

Q. What does this crest articulate with.

A. Nasal spine of frontal bone, and ethmoid bone.

Q. With what does each Nasal bone articulate.

A. With four, 2 of cranium—frontal and ethmoid, and two of face—the opposite nasal and superior maxillary.

Q. Where are the Palate Bones situated.

A. At back part of Nasal Fossa, wedged between the Superior Maxillary and pterygoid process of sphenoid.

Q. What cavities does each bone assist in forming.

A. Floor and outer wall of nose, roof of mouth and floor of orbit.

Q. What Fossa and Fissure does each bone assist in forming.

A. Spheno-maxillary and Pterygoid fossa, and Spheno-maxillary fissure.

Q. What does each Palate bone resemble in form.

A. The letter L.

Q. Into what parts is the Palate bone divided.

A. Inferior or horizontal and superior or vertical plate.

Q. What is the nature of Horizontal Plate.

A. Quadrilateral, thick, and presents 2 surfaces and 4 borders.

Q. What does the Superior Surface form.

A. Being concave from side to side, it forms back part of floor of nostril.

Q. What does the Inferior Surface form.

A. Back part of hard palate.

Q. Where is the Posterior Palatine canal.

A. At outer extremity of a transverse ridge at posterior part of inferior surface.

Q. Where are the orifices of the two accessory palatine canals.

A. Near the deep groove at the outer extremity of the transverse ridge

Q. What is the nature of the anterior border of Palate bone.

A. Serrated and bevelled, and articulates with palate process of Superior Maxillary bone.

Q. What is the nature of the posterior border.

A. Concave and free, and serves for attachment of Soft Palate.

Q. What is the Posterior Nasal Spine.

A. The inner extremity of the posterior border which is sharp and pointed when united with the opposite bone, and gives attachment to the Azygos Uvula muscle.

Q. What is the external border united with.

A. Lower part of perpendicular plate.

Q. What is the nature of the Internal border.

A. The thickest, and serrated for articulation with its fellow of opposite side.

Q. What does the superior ridge of both bones form.

A. A crest into which the vomer is received.

Q. What is the nature of the vertical Plate.

A. Thin and oblong, directed upward and a little inward.

Q. Where is the Inferior Turbinated Crest.

A. Immediately above the shallow depression which forms part of inferior meatus of nose.

Q. What does this Crest articulate with.

A. The Inferior Turbinated Bone.

Q. Where is the Superior Turbinated Crest.

A. Above the Inferior, and forms part of middle meatus.

Q. What is the nature of the external surface of Vertical Plate.

A. Rough and irregular to articulate with inner surface of superior maxillary.

Q. Where is the Posterior Palatine canal.

A. Towards the back of external surface, which canal is first a groove, until articulation with superior maxillary bone forms a canal.

Q. Where is the Maxillary Process.

A. On the anterior border of external surface opposite Inferior Turbinated Crest.

Q. Where is the Pterygoid Process, or Tuberosity of palate.

A. At the lower part of this anterior border.

Q. What is the Orbital Process.

A. A well marked process of the superior border of Vertical Plate; the fellow process which is smaller being called the Sphenoidal Process.

Q. Where are the *Malar Bones* situated.

A. At upper and outer part of face, and form prominence of cheek.

Q. What is their nature.

A. Two in number, they are quadrangular in form, and each presents external, internal surfaces and frontal, orbital, maxillary and zygomatic processes and four borders.

Q. What is the nature of External Surface.

A. Smooth and convex, and having near centre the malar foramina.

Q. What does the External Surface give attachment to.

A. Zygomaticus major and minor muscles.

Q. What is the nature of Internal Surface.

A. Concave, directed backward and inward, and presents internally a rough triangular surface for articulation with Superior Maxillary; externally a smooth concave surface which forms part of Zygomatic fossa, and affords attachment to part of Temporal muscle above, and Masseter muscle below.

Q. What is the nature of the Orbital Process.

A. A thick and strong plate which projects backward from orbital margin of bone; its upper surface, by uniting with greater wing of sphenoid, forms outer wall of orbit; its under surface, smooth and convex, forms part of temporal fossa; its anterior margin forms part of circumference of orbit; its superior margin articulates with frontal bone; its posterior margin with sphenoid; internally it articulates with orbital surface of superior maxillary; on upper surface are orifices of one or two temporo-malar canals for filaments of orbital branch of superior maxillary nerve.

Q. What is the nature of the Maxillary Process.

A. Rough and triangular; articulates with Superior Maxillary.

Q. What is the Nature of Zygomatic Process.

A. Long, narrow and serrated; articulates with Zygomatic process of temporal bone.

Q. What is the nature of the four Borders.

A. The orbital is smooth, arched and forms part of circumference of orbit; the maxillary is rough and bevelled to articulate with superior maxillary, and affords attachment to levator labii superioris proprius muscle; the temporal border is like italic letter *f*, in shape, and gives attachment to temporal fascia; the zygomatic border is continuous with lower border of zygomatic arch, and gives attachment to edge of masseter muscle.

Q. With what bones does the malar articulate.

A. Frontal, Sphenoid, Temporal, and Superior Maxillary.

Q. Where are the Inferior Turbinated Bones situated.

A. One on each side of outer wall of nasal fossa.

Q. What does each consist of.

A. A layer of thin spongy bone turned over upon itself like a scroll, extending horizontally along outer wall of nasal fossa.

Q. What is the nature of Internal Surface.

A. Convex, perforated by many apertures and traversed by grooves and canals.

Q. What is the nature of External Surface.

A. It forms part of inferior meatus; upper border is thin and irregular, and joined to bones along outer wall of nose.

Q. What is the Lachrymal Process.

A. The anterior process of the middle portion of superior border of external surface.

Q. Where is the Ethmoidal Process.

A. At junction of the two middle fourths of the bone, and joins the ethmoid.

Q. What is the Maxillary Process.

A. A thin lamina of bone curving downward and outward, and hooking over lower edge of orifice of antrum.

Q. What is the form of both extremities.

A. More or less narrow and pointed.

Q. With what bones do the Inferior Turbinated articulate.

A. The ethmoid, superior maxillary, lachrymal and palate.

Q. Where is the *Vomer* situated.

A. A single bone at back part of nasal fossæ, forming part of septum of nose.

Q. What is its nature.

A. Thin, like a ploughshare in form, and has two surfaces—lateral, and four borders.

Q. What is the nature of the Lateral Surfaces.

A. Smooth, and marked by small furrows for vessels, and by a groove on each side, sometimes a canal, called naso-palatine which transmits naso-palatine nerve.

Q. What are the nature of the Borders.

A. The superior is thickest, with a deep groove on each side of which is a horizontal wing ; the groove receives the rostrum of the sphenoid ; the inferior border is longest, broad and uneven in front where it articulates with superior maxillary bones ; thin and sharp behind where it unites with palate bones ; the upper half of anterior border consists of two laminae of bone between which is received the perpendicular plate of ethmoid ; the lower half is united to triangular cartilage of nose ; the posterior border is free, concave, and separates nasal fossæ behind ; thick bifid above, thin below.

Q. With what bones does the Vomer articulate.

A. Sphenoid, Ethmoid, 2 Superior Maxillary, 2 Palate, and with cartilage of septum of nose.

Q. Name *Cranial Nerves*, and functions of the 12 Pairs.

A. 1st	Pair Olfactory,	Special sense of smell.
2d	" Optic,	" " sight.
3d	" Motor Oculi,	Motion to 5 orbital muscles.
4th	" Pathetic,	Motion to one orbital muscle.
5th	" Trifacial,	Sensation and motion, possibly special sense of taste.
6th	" Abducens,	Motion to one orbital muscle.
7th	" Facial,	Motion to muscles of face.
8th	" Auditory,	Special sense of hearing.
9th	" Glosso-Pharyngeal,	Sensation, motion and special sense of taste.
10th	" Pneumogastric,	Sensation and motion.
11th	" Spinal accessory,	Motion.
12th	" Hypoglossal,	Motion to muscles of tongue.

Q. How many origins has a Cranial Nerve.

A. Two, superficial and deep.

Q. How do cranial nerves pass out of cranium.

A. Through base of skull.

Q. What is reflected over them as they pass out.

A. A prolongation of dura mater as a sheath.

Q. What are nerves of special sense.

A. Convey the impression made upon their peripheral ends to a particular cell of Brain.

Q. What is the *Pons Varolii.*

A. Eminence at upper part of Medulla Oblongata, formed by the union of the crura cerebri and crura cerebelli.

Q. What is the *Medulla Oblongata.*

A. Upper enlarged portion of Spinal Cord, resting on basilar process of occipital bone.

Q. What is the *Foramen Ovale.*

A. An opening in Sphenoid bone for transmission of Inferior Maxillary branch of 5th Nerve.

Q. What is the *Foramen Rotundum.*

A. Opening in Greater Wing of Sphenoid bone for transmission of Superior Maxillary branch of 5th Nerve.

Q. Describe the origin and course of 5th Pair of Nerves.

A. The pons varolii and medulla oblongata, by a large sensory or posterior root, and a small motor or anterior root. The deep origin is widely separated from the superficial origin. Backwards from anterior surface of pons varolii, the nerve passes directly through pons to medulla oblongata without any connection with its fibres, on reaching the medulla it forms 3 main divisions, one anterior and two posterior. From the superficial origin the two roots extend obliquely upward and forward across summit of petrous portion of temporal bone, and through an oval opening in dura mater into middle fossa of cranium.

Q. Where does the larger Posterior Sensory Root terminate.

A. In Gasserian Ganglion.

Q. Where is this Ganglion situated.

A. In depression on anterior surface near apex of petrous portion of temporal bone.

Q. What is the form of this Ganglion.

A. Broad, flattened somewhat semilunar or crescent-shaped ; its convexity is forward and slightly upward.

Q. What 3 large divisions arise from anterior or concave margin of the Ganglion.

A. Ophthalmic, Superior Maxillary and Inferior Maxillary.

Q. Which is the largest.

A. The Inferior Maxillary.

Q. What does the Ophthalmic supply.

A. Eyeball, lachrymal gland, mucous membrane of eye and nasal fossae, integument and muscles of eyebrow, forehead and nose.

Q. Name the terminal branches of *Ophthalmic.*

A. Lachrymal, Frontal and Nasal.

Q. Name the terminal branches of the *Superior Maxillary.*

A. Orbital or Temporo-malar, Spheno-palatine, Posterior Dental, Anterior Dental ; and on the face—Palpebral, Nasal, and Labial.

Q. Name the terminal branches of the *Inferior Maxillary.*

A. Masseteric, Deep Temporal, Buccal, and 2 Pterygoid, comprise the anterior and smaller division; while the Auriculo-temporal, Gustatory or Lingual, and Inferior Dental, comprise the posterior and larger division.

Q. Describe *Ophthalmic*, or 1st Division of 5th Nerve.

A. Smallest; arises from upper part of Gasserian Ganglion; one inch long; sensory; enters orbit through sphenoidal fissure, when it divides into the three terminal branches.

Q. Describe *Superior Maxillary*, or 2nd Division of 5th Nerve.

A. Sensory; arises from middle of Gasserian Ganglion and passes through foramen rotundum, crosses spheno-maxillary fissure and through infra-orbital canal at which foramen it emerges on face, giving off in spheno-maxillary fossa the orbital, spheno-palatine, and Posterior Dental branches; in the infra-orbital canal it gives off anterior dental branch; on face, the palpebral, nasal and labial branches.

Q. Describe the *Inferior Maxillary*, or 3d Division of 5th Nerve.

A. Largest; compound nerve, large or *sensory* root arises from inferior angle of Gasserian Ganglion; the smaller or *motor* root passes beneath this ganglion and joins sensory root just after its exit through foramen ovale; immediately beneath base of skull divides into anterior and posterior branches; the anterior is smallest and receives nearly all of the motor root giving branches to muscles of mastication; the posterior branch is largest, and for most part sensory receiving a few filaments from motor root. Supplies teeth and gums of lower jaw, temple and external ear, lower face and lip, and muscles of mastication.

Q. Describe *Inferior Dental Branch.*

A. Largest, passes downward with artery of same name, first beneath external pterygoid muscle, and then between internal lateral ligament of lower jaw, and ramus of jaw to inferior dental foramen, and then through inferior dental canal to mental foramen where it divides into incisor and mental branches.

Q. Describe course of branches of *Ophthalmic Nerve.*

A. *Frontal;* largest enters orbit through sphenoidal fissure; passes forward between Levator palpebrae muscle and periosteum; midway between apex and base of orbit it divides into two branches—supra-trochlear and supraorbital; the former goes to corrugator supercillii and occipito-frontalis muscles, and the latter supply same muscles and also the orbicularis palpebrarum. *Nasal*; enters orbit between the two heads of external rectus muscle, and passes inward to the orbit, where it enters anterior ethmoidal foramen; then enters cranium and into nose, where it divides into internal and external branches, the former supplying mucous membrane near anterior part of septum of nose, the latter supplying wing and tip of nose, and then joining with facial nerve. *Lachrymal*; smallest, passes into orbit through sphenoidal fissure to lachrymal gland supplying this gland and conjunctiva, and terminates in upper eyelid, finally joining facial nerves.

Q. Describe the course of Branches of *Superior Maxillary Nerve.*

A. *Orbital;* arises in spheno-maxillary fossa, and enters orbit by spheno-maxillary fissure, and then divides into temporal and malar; the first runs in a groove along outer wall of orbit in malar bone, and is joined by a branch of the lachrymal, and enters temporal fossa, ascends and pierces temporal muscle, and fascia and is distributed to integument of temple and side of forehead; and then joins facial and auriculo-temporal; the latter (malar), passes

along external inferior angle of orbit and emerges on face in a foramen of the malar bone, perforating orbicularis palpebrarum muscle, and supplies prominence of cheek; it also joins facial *Spheno-palatine;* two in number, descend to spheno-palatine ganglion. *Posterior Dental:* Two in number, arise from trunk as it is about to enter infra-orbital canal, divide and pass downward on tuberosity of superior maxillary bone; one of them enters a canal in this bone, passes from behind forward, and joins the anterior dental nerve opposite canine fossa. Numerous filaments form a plexus in outer wall of superior maxillary bone just above the alveoli; from this plexus filaments are given off for the pulps of the molar teeth, the lining of antrum, portion of gums; the other branch passing to the gums and mucous membrane of cheek. *Anterior Dental:* Large, is given off from superior maxillary nerve just before it emerges from infra-orbital foramen; it enters a special canal in front wall of antrum, and joins the posterior dental. In its course through the canal it gives off the *middle dental*, which supplies the bicuspid teeth. Sometimes this branch is given off directly from superior maxillary nerve in back part of infra-orbital canal, and passes in a special canal to the bicuspid teeth. Other filaments of the anterior dental nerve pass to the canine and incisor teeth, and it forms a communication with a nasal branch from Meckel's ganglion. *Palpebral:* Pass upward beneath orbicularis palpebrarum, which they supply, and also integument and conjunctiva of lower eyelid with sensation, joining facial and malar nerves at outer angle of orbit. *Nasal:* These branches pass inward and supply integument of side of nose and join nasal branch of ophthalmic. *Labial:* Largest and most numerous, descend beneath Levator labii superioris to integument and muscles of upper lip, mucous membrane of mouth, and labial glands; the infra-orbital plexus is formed by filaments from facial which join these branches just beneath orbit.

Q. Describe *Spheno-palatine or Meckel's Ganglion.*

A. Largest of cranial ganglia, placed in spheno-maxillary fossa, close to spheno-palatine foramen; triangular; reddish-gray color, situated just below superior maxillary nerve as it crosses the fossa.

Q. Describe course of anterior Branches of *Inferior Maxillary Nerve.*

A. *Masseteric:* Outward course above External pterygoid muscle in front of temporo-maxillary articulation; crosses sigmoid notch to masseter muscle as far as anterior border.

Deep Temporal: Two in number, anterior and posterior; supply deep surface of temporal muscle; posterior branch small, and situated back of temporal fossa; anterior branch reflected upward at pterygoid ridge of sphenoid bone, to front of temporal fossa; generally given off from buccal nerve.

Buccal: Pierces external pterygoid and passes down beneath coronoid process of lower jaw, or through temporal muscle, to buccinator where it divides into superior and inferior branches, and gives a branch to external pterygoid and a few filaments to temporal muscle; the superior branch supplies integument and part of buccinator muscle and joins with facial; inferior branch passes to angle of mouth and supplies same parts as superior, and also joins facial nerve. *Pterygoid:* Two in number, one supplying each pterygoid muscle; the branch to internal pterygoid passes inward to deep surface; connected at its origin with otic ganglion; frequently derived from buccal.

Q. Describe the Posterior Branches of *Inferior Maxillary.*

A. The larger division and mostly sensory, but receives a few filaments from motor root.

Q. Into how many branches does it divide.

A. Three—Auriculo-temporal, Gustatory, and Inferior Dental.

Q. Describe these Branches.

A. *Auriculo-temporal:* Arises by 2 roots and runs backward beneath external pterygoid muscle to inner side of neck of lower jaw; then upward between external ear and condyle of jaw under parotid gland, and ascends over zygoma, and divides into two temporal branches, the *posterior* being the smaller, and distributed to pinna of ear and adjoining tissues; the *anterior* passes to vertex of skull, and supplies integument of temple, joining with facial and orbital of superior maxillary; the auriculo-temporal communicates with otic ganglion.

Lingual or Gustatory: Supplies papillae and mucous membrane of tongue; passes between internal pterygoid muscle and inner side of ramus of jaw, and crosses to tongue across Wharton's duct, along side of tongue to apex, immediately beneath mucous membrane, its branches supply mucous membrane of mouth, gums, sublingual gland, papillae and mucous membrane of tongue, anastomosing with hypoglossal nerve at tip of tongue.

Inferior Dental: Largest of the three branches of Inferior Maxillary; passes downward with inferior dental artery beneath external pterygoid muscle and then between internal lateral ligament and ramus of jaw to dental foramen, which it enters, and then passes through dental canal of inferior maxillary bone, beneath the teeth as far as the mental foramen, where it divides into two terminal branches—*incisor* and *mental*. While in the dental canal it sends filaments to the molar and bicuspid teeth; the *incisor branch* continues forward within the bone to median line, supplying the canine and incisor teeth; the *mental branch* emerges at mental foramen, and its two or three branches supply skin and mucous membrane of lower lip. *Mylo-hyoid:* Leaves inferior dental nerve as the latter is about to enter dental foramen; it descends in a groove on inner surface of ramus, and sends filaments to mylo-hyoid and digastric muscles, and to submaxillary gland.

Q. What two small ganglia are connected with the inferior maxillary nerve.

A. Otic and Submaxillary.

Q. Describe *Otic Ganglion.*

A. Small, oval, flattened; reddish gray color, situated immediately below foramen ovale on inner surface of inferior maxillary nerve, it is in relation with the latter nerve at a point where a motor root joins the sensory portion, being thus connected by two or three filaments, and also with the auriculo-temporal nerve; this connection with the auriculo-temporal accounts for earache during dentition.

Q. What are the principal Arteries supplying the Head.

A. Two Vertebral and two common Carotid.

Q. Describe *Common Carotid Arteries.*

A. Right and Left; about ½ inch in calibre and are similar in position and course through the neck on either side; the Right is the shorter, and is more superficial than the Left; it is one of the terminal branches of the innomiuate artery, which arises from arch of aorta on right side, the other branch being the Subclavian.

Q. Describe *Left Common Carotid.*

A. Arises from left of arch of aorta, passes upward and a little outward to

left of sterno-clavicular articulation, and then pursues same course as right common carotid ; it is situated just behind upper portion of sternum.

Q. Where do the Common Carotids terminate.

A. Opposite upper border of thyroid cartilage, without giving off any branches.

Q. What are the two branches of each common carotid.

A. External and Internal Carotids.

Q. Describe *External Carotid.*

A. One fourth of an inch in calibre ; arises from common carotid in the carotid triangle, opposite upper border of thyroid cartilage ; passes up neck to a point opposite neck of lower jaw where it divides into two terminal branches—Internal Maxillary and Superficial Temporal.

Q. What are the Branches of External Carotid.

A. Eight—Superior Thyroid, Lingual, Facial, Occipital, Posterior Auricular, Ascending-pharyngeal, Temporal and Internal Maxillary.

Q. Describe the *Superior Thyroid Artery.*

A. The first branch of External Carotid ; 1-7 inch in calibre ; arises close to bifurcation of common carotid ; passes upward, forward and downward to thyroid cartilage, and thence to thyroid gland.

Q. Describe the *Lingual Artery.*

A. Arises opposite the hyoid bone ; passes upward, downward, upward again, to under surface of tongue to its tip, where it ends in the Ranine artery, which is very superficial ; 1-7 inch in calibre.

Q. Describe *Facial Artery.*

A. Arises a little above lingual ; passes upward, forward, inward, again forward within Submaxillary Gland, extending parallel with base of lower jaw ; leaving gland, it makes a sharp turn upward over edge of body of jaw, curving through a notch in front of masseter muscle ;quite superficial over body of jaw, and flow of blood can be controlled by pressing artery against edge of bone ; it then passes obliquely upward and forward towards inner canthus of eye where it ends as the *angular* artery ; from body of jaw it passes near angle of mouth and ends in Levator labii superioris alæque nasi muscle.

Q. How are the Branches of Facial divided.

A. Into Cervical and Facial.

Q. What are the Cervical and Facial Branches.

A. *Cervical Inferior or Ascending Palatine*—supplies stylo-glossus and stylo-pharyngeus muscles, soft palate and palatine glands ; *Tonsillar*—supplies tonsil and root of tongue ; *Submaxillary*—supplies submaxillary gland, lymphatic glands, neighboring muscles and integuments ; *Submental*—largest, supplies muscles attached to jaw, a superficial branch supplying depressor labii inferioris muscle and integument, and a deep branch supplying lower lip; the muscular branches supply internal pterygoid and stylo-hyoid, masseter and buccinator muscles. Facial Branches : *Inferior labial* supplies muscles and integument of lower lip ; *inferior coronary* supplies labial glands, mucous membranes, and muscles of lower lip ; *superior coronary* supplies upper lip and nose ; *lateralis nasi* supplies wing and dorsum of nose ; *angular* supplies cheek, lachrymal sac, and orbicularis muscle.

Q. Describe *Occipital Artery.*

A. Arises from posterior part of external carotid opposite the facial, covered by part of parotid gland, and higher up passes across internal carotid artery,

internal jugular vein, and pneumogastric and spinal accessory nerves; ascends, passes backward in a groove of temporal bone, and vertically upwards over occiput where it divides into numerous branches.

Q. Describe *Posterior Auricular Artery.*

A. Small, arises opposite apex of styloid process, ascends covered by parotid gland to groove between cartilage of ear and mastoid process where it divides into *interior* branch, which supplies back of auricle and *posterior* branch supplies scalp above and behind ear. The posterior auricular also supplies digastric, stylo-hyoid, and sterno-mastoid muscles, and parotid gland, and divides into stylo-mastoid and auricular branches.

Q. Describe *Ascending Pharyngeal Artery.*

A. Smallest of external carotid branches; deep in neck; arises from back part near beginning of carotid; ascends vertically to under surface of base of skull; supplies muscles and nerves of neck; and a pharyngeal branch goes to tympanum; and a meningeal branch to dura mater.

Q. Describe *Temporal Artery.*

A. Smaller of the two terminal branches of external carotid; begins in parotid gland between neck of condyle of lower jaw and external meatus, crosses root of zygoma just beneath integument, and two inches above zygomatic arch divides into *anterior* and *posterior* branches; the anterior passes over forehead and supplies muscles etc., of that region and can be felt when used to note the pulse; the posterior temporal is larger, and curves upward and backward along side of head and joins its fellow of opposite side.

Q. What are the Branches of *Temporal artery.*

A. Besides some small branches to parotid gland, temporo-maxillary articulation, and masseter muscle, its branches are the *transverse facial*, given off in parotid gland, passes across face between Steno's duct and lower border of zygoma, and divides on side of face into numerous branches which supply parotid gland, masseter muscle, and integument; it rests on masseter muscle; *middle temporal* arises just above zygomatic arch, and supplies temporal muscle, and a branch goes to orbicularis palpebrarum; *anterior auricular* branches go to external ear.

Q. Describe *Internal Maxillary Artery.*

A. Larger of the two terminal branches of external carotid; passes inward, at right angles to carotid, to inner side of condyle of lower jaw, to supply deep structures of face; at its origin is imbedded in parotid gland; situated on level with lower end of lobe of ear; it passes forward and inward between ramus of jaw and internal lateral ligament; crosses inferior dental nerve and lies beneath external pterygoid muscle; in 2nd part of its course, it passes obliquely forward and upward, back of ramus of jaw and lower part of temporal muscle; in 3d part of its course, it approaches superior maxillary bone; enters spheno-maxillary fossa, and lies in relation to Meckel's ganglion.

Q. What are the Branches of Maxillary Portion of Internal Maxillary.

A. *Tympanic* to tympanum; *Middle Meningeal* to dura mater; *Small Meningeal* to Gasserian ganglion, and dura mater; and *Inferior dental.*

Q. Describe *Inferior Dental Artery.*

A. Descends with dental nerve to foramen on inner side of ramus of lower jaw; passes along dental canal in body of lower jaw giving off branches to molar and bicuspid teeth; opposite 1st bicuspid it divides into two branches—*incisor* and *mental*; incisor branch continues forward in bone beneath incisor

teeth and gives off branches which supply inferior canines and incisors, as far as symphysis, where it anastomoses with same artery on opposite side; mental branch emerges with nerve at mental foramen and supplies chin, and anastomoses with submental, inferior labial, and inferior coronary arteries.

Q. Where is *Mylo-hyoid* branch of Inferior dental given off.

A. As the inferior dental enters dental foramen; it runs in mylo-hyoid groove and ramifies under surface of mylo-hyoid muscle.

Q. What are the Branches of the Pterygoid Portion of Internal Maxillary.

A. *Deep Temporal*, two in number which supply temporal muscle; *Pterygoid*, which supply pterygoid muscles; *Masseteric*, which passes above sigmoid notch to supply masseteric muscle; *Buccal*, a small branch which runs forward to supply buccinator muscle.

Q. What are the Branches of the Spheno-maxillary Portion of Internal Maxillary.

A. *Alveolar or Posterior Dental*, which is given off by a common branch with the infraorbital just as the trunk is passing into spheno-maxillary fossa; it descends upon tuberosity of superior maxillary bone and divides into numerous branches, some entering the posterior dental canals to supply molar and bicuspid teeth and lining of antrum; others continue forward on alveolar process to supply the gums; *infraorbital*, a continuation of internal maxillary; arises by a common trunk with posterior dental, and passes along infraorbital canal with superior maxillary nerve, emerging on face at infraorbital foramen. In the canal it gives off branches to orbit, lachrymal gland and muscles of the eye; other branches called *anterior dental* descend through canals in bone to supply mucous membrane of antrum and the upper front teeth; on face it supplies lachrymal sac, inner angle of orbit, and anastomoses with facial, and nasal of ophthalmic; *descending palatine* passes down along posterior palatine canal; emerges from posterior palatine foramen, runs forward on inner side of alveolar border of hard palate to anterior palatine canal; its branches go to the gums, mucous membrane of hard palate, and palatine glands, while in palatine canal, branches leave it to supply soft palate and tonsils; *vidian*, passes along vidian canal to pharynx, Eustachian tube and tympanum; *pterygo-palatine*, passes through pterygo-palatine canal to pharynx and Eustachian tube; *nasal or spheno-palatine* passes through foramen of same name into cavity of nose, and its branches supply nose, antrum and ethmoid and sphenoid cells.

Q. Describe *Internal Carotid Artery*.

A. Commences at bifurcation of common carotid, opposite upper border of thyroid cartilage; runs upward to carotid foramen in petrous portion of temporal bone; then forward and inward through carotid canal into skull; then ascends to posterior clinoid process, forward through cavernous sinus; then upward, pierces dura mater and divides into terminal branches; it supplies anterior part of brain, eye and appendages, forehead and nose.

Q. What does the term "anastomoses" imply.

A. The union or inosculation of one blood-vessel with another.

Q. Name, with the origin, insertion and action, each of the muscles concerned in the movements of Lower Jaw.

ANSWER:	*Origin.*	*Insertion.*	*Action.*
Temporal.	Temporal fossa and fascia.	Coronoid process.	To bring incisor teeth together.

Masseter.	*Origin.*	*Insertion.*	*Action.*
	From anterior ⅔ and inner surface of Zygoma and malar process of superior maxillary.	Angle, ramus and coronoid process of lower jaw.	Raise back part of lower jaw; Muscle of mastication.
External Pterygoid.			
	Upper head from pterygoid ridge, great wing of Sphenoid, Lower head from External pterygoid plate and tuberosities of palate and superior maxillary bones.	Depression in front of condyle of lower jaw and inter-articular fibro-cartilage.	To draw jaw forward.
Internal Pterygoid.			
	Pterygoid fossa of spheuoid, and tuberosity of palate.	Angle and inner surface of ramus as high as dental foramen.	Raise and draw forward lower jaw.
Digastric.			
	By two bellies:—posterior from mastoid process of temporal bone; anterior from fossa on inferior maxillary near symphysis.	Into central tendon, perforating stylo-hyoid muscle; bound down to hyoid boue by aponeurotic loop.	To raise hyoid bone and tongue and draw down lower jaw.
Omo-Hyoid.			
	Upper border of Scapula.	Hyoid Bone.	To depress and draw backward hyoid bone and depress lower jaw.
Mylo-hyoid.			
	Mylo-hyoid ridge.	Hyoid bone.	To elevate and draw forward hyoid bone and depress lower jaw.
Genio-hyoid.			
	Inferior genial tubercle of inferior maxillary.	Hyoid bone.	Elevates and draws forward hyoid bone, and depresses jaw.
Platysma Myoides.			
	Cellular tissue and integuments below clavicle.	Chin and fascia of lower jaw.	To depress mouth and wrinkle skin.

Q. Name principal *Muscles of Expression*, with origin, insertion and action.

ANSWER:—	*Origin.*	*Insertion.*	*Action.*
Orbicularis Oris.			
	Nasal septum and inferior and superior maxillary borders.	Buccinator and adjacent muscles.	To close mouth.
Levator labii superioris alaeque nasi.			
	Nasal process of Superior Maxillary.	Cartilage of wing of nose and upper lip.	To elevate upper lip and dilate nostril.
Levâtor labii superioris.			
	Lower margin of orbit.	Upper lip.	To elevate the lip.
Levator anguli oris.			
	Canine fossa of Superior maxillary.	Angle of mouth.	To elevate angle of mouth.
Zygomaticus Major.			
	Malar bone.	Angle of mouth.	To raise lip outward.
Zygomaticus Minor.			
	Malar bone.	Angle of mouth.	To raise lip outwards.
Levator Labii Inferioris.			
	Incisive fossa of Inferior Maxillary.	Integument of lower lip.	To elevate lower lip.

	Origin.	*Insertion.*	*Action.*
Depressor Labii Inferioris.	External oblique line of Inferior Maxillary.	Lower lip.	To depress lower lip.
Depressor anguli oris.	External oblique line of inferior maxillary.	Angle of mouth.	To depress angle of mouth.
Buccinator.	Posterior alveolar process of both jaws.	Orbicularis oris.	To compress cheeks.
Risorius.	Fascia over masseter muscle.	Angle of mouth.	The laughing muscle.

Q. What is the condition of Fibres of *Peridental Membrane* next to the bone.

A. So thick as to represent bundles.

Q. What is the nature of Peridental Membrane on surface in contact with the cementum.

A. A fine network of interlacing bands closely connected with surface of cementum.

Q. How do the thicker fibres of its outer surface pass into the fine network of inner surface.

A. Insensibility where inner surface is more richly cellular.

Q. What are found on inner surface.

A. Large, soft nucleated plasma masses—cementoblasts.

Q. What is the office of the Peridental Membrane.

A. *Functional*, so far as it is the membrane in which osteoblasts that form alveolar walls, and cementoblasts that form cementum, are developed; *Physical*, so far as the function of securing tooth in cavity; *Sensory*, so far as it is the organ of touch of the tooth, on account of its abundance of nerves.

Q. What other cells besides osteoblasts and cementoblasts are found in the Peridental Membrane.

A. Fibroblasts for renewal of fibrous tissues; Osteoclasts for removal of alveolar walls for change in position of tooth, or for change of form of root through the cementum.

Q. When are Osteoblasts developed.

A. As occasion requires; but are generally present somewhere within alveolus.

Q. Does the Peridental Membrane contain Lymphatics.

A. Yes, peculiar to itself, and many in contact with cementum.

Q. Into how many parts is it divided.

A. Three—*Gingival*, portion about neck of tooth and below margin of alveolar cavity; *Apical*, portion occupying apical space; *Body*, portion from margin of alveolar wall to apical space.

Q. How are the arteries distributed over Peridental Membrane.

A. Larger ones enter root canal to supply pulp, while the others four, six or eight in number, pass along sides of root to this membrane; passing along membrane they divide into many branches, a number of which enter Haversian canals of alveolar walls, or receive branches from such a source.

Q. Describe nerve supply of Peridental Membrane.

A. Nerves are received by it in same manner as the arteries; a rich plexus is formed at gingival border.

Q. What function does the nerves give to this membrane.

A. They render it the organ of touch, as the enamel has not such a sense.

Q. When normal is it very susceptible to irritation.

A. No, but is very painful when inflamed.

Q. Are the nerves supplied to this membrane through the alveolar walls sufficient to maintain its sensory function.

A. Yes, Example : Large acute abscess in apical space.

Q. What is the exposed surface of *Gums* covered with.

A. A dense, squamous epithelium to withstand severe abrading by the food, etc.

Q. What does the exposed surface of gums rest upon.

A. On a layer of softer epithelial cells which cover a series of papillæ rising from fibrous tissue beneath ; and all rest on upper edge of alveolar process, and the dense epithelial covering is drawn tightly around necks of teeth forming a strong resistant, but flexible, cushion to the tissues it protects.

Q. What has been called the Dental Ligament.

A. The radiating bundles of fibrous tissue which form the strong attachment of gum to necks of teeth.

Q. How far does this attachment to tooth extend from extreme edge.

A. One-eighth to three-eighths of an inch, varying in different persons and about different teeth.

Q. In what respects does the inner surface of free margin of gums differ from other parts.

A. It is covered with a soft polygonal gland-like epithelium, but it has no gland structure.

Q. What is it called.

A. The Gingival organ.

Q. What does it secrete.

A. A profusion of Mucous Corpuscles.

Q. When they accumulate and are mixed with micro-organisms what is formed under free margins of gums.

A. A soft, cheesy mass like pus, and often mistaken for it.

Q. Describe structure of *Salivary Glands.*

A. Consist of numerous lobes made up of smaller lobules connected by dense areolar tissue, vessels, and ducts.

Q. What does each lobule consist of

A. Numerous closed vessicles which open into a common duct.

Q. What arteries and nerves pass through and lie close to Parotid Gland

A. External Carotid, Internal Carotid arteries, Internal Jugular vein ; and Facial nerve.

Q. What artery lies in a groove in Submaxillary Gland.

A. Facial artery.

PHYSIOLOGY.

Q. In the chemical basis of the body, what is the proportion of oxygen, carbon, hydrogen, and nitrogen taken together.

A. About ninety-seven per cent.

Q. What other elements are present in small quantities.

A. Sulphur, chlorine, phosphorous, silica fluorine, sodium, potassium, calcium, magnesium, and iron.

Q. What two important groups of substances form the body.

A. Nitrogenous and non-nitrogenous.

Q. Which of these perform the most important functions, and all the active portions of the organism.

A. The Nitrogenous.

Q. What are Proteids.

A. The albumins and albuminoid constituents of the organism.

Q. What are they precipitated from.

A. From solutions by alcohol and different metallic salts, coagulated by heat and mineral acids.

Q. What do the Carbo-Hydrates include.

A. Starches and sugars.

Q. Are Fats widely distributed in plants and animals.

A. Yes; they contain little oxygen.

Q. What is the function of the *Blood*.

A. It distributes nutritious materials to all parts of the system, and collects substances no longer needed on account of change going on in the tissues, and carries them to organs which discharge them from the body.

Q. What is the color of Blood in different parts of the system.

A. In systemic arteries of a bright scarlet-red; in corresponding veins of a dark bluish color; in pulmonary artery a dark blue; in pulmonary veins scarlet.

Q. What is the variation in color due to.

A. Oxygen of the air.

Q. What is the reaction of the blood.

A. Alkaline, due to presence of sodium carbonate and disodic phosphate.

Q. What does the odor of blood depend upon.

A. Presence of volatile fatty acids.

Q. What is the taste of blood.

A. Saline, due to the salts it contains.

Q. What is the temperature of the blood.

A. Varies from 98° F., at surface of body to 107° in hepatic vein.

Q. How does blood differ in character.

A. Arterial blood has more oxygen, and is more coagulable; blood of portal vein varies with stages of digestion when it contains more water, albuminous matters, and sugars, and less corpuscles; in hepatic vein there is more sugar, but less albumen and fibrin.

Q. What are White Blood Corpuscles.

A. Small protoplasmic cells, occuring in large quantities in the lymph; of a finely granular structure, and nuclei; they have an amœboid movement and migrate through bloodvessel wall and the tissues; larger than the red disks, and have no cell wall.

Q. What are Red Blood Corpuscles.

A. They give red color to blood; soft, elastic, and alter shape when passing through small vessels, and then resume normal shape, as soon as pressure is removed; no nuclei; many in number.

Q. What is the size of red blood corpuscles of man.

A. About 1-3200 inch in diameter, and 1-12400 inch thick.

Q. What is the size of white corpuscles.

A. About 1-2500 inch in diameter.

Q. What is the nature of White corpuscles.

A. Flattened bi-or tri-nucleated cells; possess a contractile power and closely resemble amœbae; most numerous in venous blood; contain several nuclei.

Q. What is the function of Red Blood Corpuscles.

A. To absorb oxygen and carry it to the tissues, all the vital functions becoming more active.

Q. What is the difference in movement between the white aud red corpuscles.

A. The white in the interior of vessels adhere to inner surface, while the red move through the centre of stream.

Q. What is hæmoglobin.

A. The substance that gives red color to corpuscles, and by their aid carries oxygen to the tissues; a crystalline matter.

Q. What is *hæmatin*.

A. Red coloring matter of the blood. An amorphous principle of the blood, with steel-black metallic lustre; not to be confounded with "hematin," a synonym of hæmatoxylin, Hæmatin is the result of decomposition of hæmoglobin.

Q. Name the Gases of the blood.

A. Chiefly oxygeu, carbonic acid, and nitrogen.

Q. Quantity of blood in body.

A. Equal to one-thirteenth part of weight of body.

Q. What is coagulation or clotting of Blood due to.

A. Presence of *fibrin*.

Q. How is the Clot made up.

A. Fibrin forms in fibrils which entangle blood corpuscles, as in a web.

Q. What may prevent or delay coagulation.

A. Alkalies or their neutral salts; egg-albumen, syrup, glycerine, water, oil, or cold at freezing point.

Q. What may hasten coagulation.

A. Contact with any foreign body, heating from 39° to 55° C., or constant agitation.

Q. What is the function of the Heart.

A. To propel blood through body.

Q. How does the right side differ from left side of Heart.

A. The right side takes venous blood from vena cava and propels it through lungs to left side.

Q. What is circulation of right side called.

A. Pulmonic circulatiou.

Q. What is the function of auricle of heart.

A. To force blood through auriculo-ventricular opening and to supply ventricles.

Q. What is the function of Valves of Heart.

A. They prevent regurgitation of blood.

Q. How does the Blood circulate through the heart.

A. It enters right auricle from cavæ, and passes from right auriculo-ventricular opening into right ventricle, then through pulmonary artery into lungs; from lungs through pulmouary veins to left auricle, and through left

auriculo-ventricular orifice to left ventricle ; from the ventricles through aorta and thus through arterial system.

Q. What are the movements of the heart.

A. Contraction, or systole ; expansion, or diastole.

Q. What are the sounds of the Heart.

A. First sound, long and dull from closure and vibration of auriculo-ventricular valve, contraction of walls of ventricles and apex beat ; second sound, short and sharp, from closure of semilunar valves.

Q. What is the rate of heart beats.

A. Before birth, per minute, 140-150 ; during 1st year, 125-135 ; 3d year, 95-100 ; 8th, 9th, to 14th year, 85-90; adult, about 72.

Q. In what sex is the Pulse most rapid.

A. Female.

Q. What effect has posture on pulse.

A. Erect causes a more rapid pulse than the prostrate; respiratory changes, small repeated swallows of water, etc., influence its rate.

Q. What is meant by blood-pressure.

A. That under which the stream is kept up by the action of heart and walls of blood-vessels.

Q. What are the nerves which influence blood-pressure called.

A. Vaso-motor.

Q. What effect has galvanism on blood-pressure.

A. It raises it.

Q. What effect has asphyxia on blood-pressure.

A. It increases it by stimulation of vaso-motor centre in medulla.

Q. What assists flow of blood in Capillaries.

A. Capillary attraction and pressure due to the muscular movements of body ; the action of the heart and coats of the arteries.

Q. What causes the pulse.

A. A wave of force which passes along column of blood in artery due to a single contraction of heart, so that each pulse represents a heart beat, but not the blood thrown out at that beat.

Q. At what speed does the blood circulate.

A. Thirty-five feet per second.

Q. What is the object of *Respiration*.

A. To bring oxygen of air in close relationship with the hæmoglobin in blood, and to permit of elimination of carbonic acid gas, and other effete products from body.

Q. What do the movements of chest represent.

A. Enlargement represents inspiration, and contraction expiration.

Q. What is the function of the pulmonary artery.

A. Supplies blood for æration.

Q. What is the function of bronchial artery.

A. Supplies blood for nourishment of lung tissue.

Q. How is blood brought to vesicles and exposed to the air.

A. The smaller branches of pulmonary artery divide more and more and do not anastomose with each other ; the minute capillaries pass between the air vesicles, the thin wall of vessel and vesicle permitting a free interchange of gases to take place.

Q. What pathological conditions of blood.

A. Plethora—increase in volume or quantity; Anæmia—deficiency of red globules and increase in water; Leucocythemia—increase of white and diminution of red corpuscles; Glycohæmia—excess of sugar; Uræmia—increase of urea; Cholesteræmia—excess of cholesterine; Thrombosis and Embolism—clotting of blood in vessels and coagula; Lipæmia—excess of fat; Melanæmia—pigment in blood.

Q. Describe *Inspiration.*

A. The side walls and front of chest move upward and outward and a vacuum is thus made, and air rushes in to equalize the internal and external atmospheric pressure; the antero-posterior diameter of chest is increased by raising of anterior part of ribs, the posterior ends being fast in spinal column; the increase in lateral diameter is due to outward movement of ribs; the increase in vertical diameter by descent of diaphragm, its convex surface becoming less arched; the diaphragm is the most important respiratory muscle.

Q. Describe Expiration.

A. These movements occur passively by the weight of chest, which sinks down, displacing the air, aided by the elastic tissue of lungs; when it is forced, the abdominal muscles pull down the chest.

Q. What is the effect of sex on Respiration.

A. In males it is largely abdominal; in females chiefly costal or thoracic.

Q. What sounds issue from chest.

A. Respiratory murmurs, caused by passage of air in and out of respiratory apparatus.

Q. What is the number of respirations per minute.

A. Fourteen to twenty; but number is influenced by sex, age, position, and exertion.

Q. Does age affect the amount of CO_2 exhaled.

A. Yes, it increases from eight to thirty-two years, remains almost stationary from thirty-five to fifty; after fifty it constantly diminishes, and at eighty years is no more than in a child of ten years.

Q. What effect has the quickening of respiration on amount of CO_2.

A. The quicker, the less amount in each respiration, but aggregate amount is increased.

Q. How much Oxygen is abstracted from every volume of air.

A. About four and a half per cent.

Q. What does *Eupnœa* signify.

A. A normal breathing

Q. What does *apnœa* signify.

A. Too much oxygen absorbed blood.

Q. What does *dyspnœa* signify.

A. Labored or difficult breathing.

Q. What is *hiccough.*

A. A sudden inspiration due to descent of diaphragm.

Q. What are the three forms of *Digestion.*

A. Salivary, Gastric and Intestinal.

Q. What is the function of Salivary Digestion.

A. To convert starch into sugar.

Q. On what does Gastric Digestion act.

A. Proteids, converting them into peptones.

Q. What is Intestinal Digestion.

A. The preparation for assimilation of fats, and conversion of proteids into peptones.

Q. What are the characteristics of Saliva.

A. A mixture of secretions of the Parotid, Submaxillary and Sublingual Glands; tasteless, slightly turbid, distinctly alkaline reaction; specific gravity 1.004 to 1.008; contains five-tenths per cent. of solids, the most of which are organic, as mucin which causes viscidity, traces of albumen and globulin, and a peculiar ferment-ptyalin; the inorganic are salts, the principal one being sulphocyanate of potash; together with salivary corpuscles, epithelial cells, and micro-organisms.

Q. What is the quantity of Saliva secreted in 24 hours.

A. From 7 to 70 ounces.

Q. What is the nature of *Parotid Saliva.*

A. It contains ptyalin, urea, traces of a volatile acid, and such inorganic constituents as salts of soda and potash; containing more of the ptyalin and less of urea than that of the other glands; it is also much thinner.

Q. What is the nature of *Submaxillary Saliva.*

A. Decidedly alkaline and tenacious or viscid; contains mucin, but less ptyalin than the parotid.

Q. What is the nature of *Sublingual Saliva.*

A. More viscid and cohesive than the others; contains much mucin, salivary corpuscles and sulphocyanate of potash.

Q. What is the composition of the *Oral Fluid* composed of all the secretions mingled together.

A. Water,	994.10
Solid Constituents,	5.90
Epithelium and mucus,	2.13
Fat,	0.70
Mucin, ptyalin, and traces of alcoholic extracts,	1.41
Sulpho-cyanide of potassium,	0.10
Alkalies, earths, and oxide of iron,	2.19

Also small quantities of nitrogen, more oxygen, and yet more of carbonic acid gas.

Q. What is the effect of stimulation.

A. Increased flow, and glandular vascularity.

Q. What effect has mastication on the flow of Saliva.

A. Increases it.

Q. What condition may increase the flow of Saliva.

A. Nausea by a reflex through vagus nerve.

Q. What is the Physiological action of Saliva.

A. The transformation of starch into dextrin, and of dextrin into sugar.

Q. Upon what does the power of saliva to convert starch into sugar (diastaltic) depend.

A. Upon ptyalin.

Q. What is *Maltose.*

A. Sugar formed by action of saliva on starch.

Q. What are the mechanical uses of Saliva.

A. Keeps mouth moist; facilitates speech; renders mastication easy, and also movements of tongue; dissolves substances, and assists taste, and also assists deglutition.

Q. What muscles are concerned in Mastication.

A. The combined action of temporal, masseter, and internal pterygoids elevate the jaw; the digastrics, mylo-hyoids, genio-hyoids, and platysmas depress the jaw ; the displacement of the articular surfaces backward or forward is produced, when forward by external pterygoids, which pull jaw down and forward; one external pterygoid acting, the jaw is pulled sideways, causing a grinding motion ; when backward the digastric and hyoid act.

Q. What is the influence of Tongue in mastication.

A. To keep food between teeth, and it is assisted by muscles of lips and buccinators.

Q. Describe process of *deglutition.*

A. Opening of mouth is closed by orbicularis oris ; the muscles of mastication press jaws together ; the tongue is pressed against hard palate, first its tip, then middle and root, forcing food backwards ; at same time levator palati draws soft palate upward and backward, completely closing the posterior openings of nasal cavities, and muscles of larynx firmly close rima glottidis ; after anterior arch is passed, the food is prevented from returning to mouth by palato-glossi muscles ; and the constrictors of the pharynx urge it on to œsophagus ; and it is further propelled by the muscular fibres of œsophagus which contract peristaltically when there is forced deglutition, as ordinarily the food is projected into œsophagus by the voluntary muscles.

Q. What nerves govern deglutition.

A. The efferent nerves.

Q. What govern the movements of the œsophagus.

A. The vagus and trifacial.

Q. What is the nature of Gastric Juice.

A. Rather clear, colorless (or straw-colored), of acid reaction, sour taste, peculiar odor.

Q. What is the quantity secreted in twenty-four hours.

A. From eight to fourteen pounds.

Q. What does it contain.

A. Pepsin, hydrochloric acid, the chief acid, and a little lactic acid.

Q. What is the function of the Pepsin, and Lactic Acid.

A. Pepsin dissolves proteids ; while lactic acid digests them like hydrochloric acid.

Q. What is *Chyme.*

A. Mixture of food and gastric juice.

Q. What is the effect of gastric juice upon proteids.

A. Changes them into acid albumen, or syntonin, which is at once changed into propeptone or hemi-albuminose ; the latter being converted into peptone which is absorbed into the blood from small intestine, and changed back into proteids and so deposited in the tissues.

Q. What other special ferment is in stomach.

A. Milk-curdling ferment.

Q. What is the nature of the Pancreatic juice.

A. Thick, transparent, odorless, saltish taste.

Q. What is its action.

A. Powerfully digestive.

Q. What is the function of Pancreatic Juice.

A. Containing four hydrolytic ferments, it is a very important digestive fluid.

Q. What is its action on fats.

A. Forms them into a fine emulsion and at last into fatty acids,

Q. When is the pancreatic juice poured out.

A. When the food enters small intestine from stomach.

Q. What are the functions of the *Liver*.

A. Secretions of bile; formation of glycogen, and destruction of worn out blood cells.

Q. What is *Bile*.

A. A yellowish brown or dark green transparent fluid with neutral reaction and bitter taste; it is the juice secreted by the liver.

Q. What does it contain.

A. Mucus from gall-bladder; bile acids, glyco-cholic, and tauro-cholic acid the most abundant in man.

Q. What is Cholestrin.

A. An univalent alcohol found in solution in bile.

Q. What quantity of bile is secreted per day.

A. About seventeen ounces.

Q. What are the functions of bile.

A. Emulsification of fats, lubrication of walls of intestine and to facilitate absorption of fats; prevents decomposition and stimulates peristalic action.

Q. What is the function of large intestine.

A. It absorbs liquids from fecal matter of small intestine.

Q. How does *absorption* occur.

A. In two ways: By means of blood-capillaries and the lacteals.

Q. What are absorbed by capillaries and by lacteals.

A. The first absorb sugars and proteids, and the latter the fats.

Q. Where is the greatest amount of absorption carried on.

A. In the upper half of the small intestine.

Q. What three forces are in action in absorption of digested food.

A. Endosmosis, diffusion, and filtration.

Q. What is Endosmosis.

A. The change which occurs between two fluids capable of forming an intimate mixture with each other through an animal membrane.

Q. What is Diffusion.

A. Mixing of two liquids, one over the other, in a vessel without presence of a septum.

Q. What is the normal temperature of man.

A. 98⅝° F.

Q. What difference in temperature between various parts of the body.

A. Surfaces of hands and feet cooler than any other portion, liver as high at times as 105° F.

Q. What is the source of animal heat.

A. The potential energy taken into body with food, and with oxygen during respiration; the amount depending upon that of kinetic energy liberated.

Q. What are the direct sources of heat.

A. The blood is charged with more carbon, hydrogen and oxygen than is required for repair of tissues, and these gases uniting with the sulphates develop heat by chemical means, while the rest of heat of body is developed by a slower combustion.

Q. What keeps temperature of body uniform.

A. Circulation of blood, which distributes heat evenly.

Q. What effect has perspiration on heat of body.

A. By its evaporation it tends greatly to dissipate heat formed too rapidly.

Q. What is *Asphyxia* due to.

A. Failure of respiration.

Q. What is *Secretion*.

A. The separation from the blood of some product, either directly or indirectly, by the vital process peculiar to a gland or membrane; the Kidney is an example of an excreting gland; the pancreas or mammary gland, an example of a secreting gland.

Q. What is the function of the *Kidneys*.

A. The secretion of urine.

Q. What is the principal solid of the urine.

A. Urea, the substance by which the nitrogen of decomposed tissue is given off.

Q. What condition occurs when urea is not freely eliminated.

A. Uræmia.

Q. What is the origin of urea.

A. Derived from portions of unassimilated elements of nitrogenous food, and from breaking down of tissue, or tissue waste.

Q. What is uric acid.

A. An acid in small quantity in human urine.

Q. How much of the body is made up of water.

A. 58.5 per cent., continually taken in and given off.

Materia Medica and Therapeutics.

Q. What precautions should be observed in the administration of Ether, Chloroform, etc.

A. Assured that patient is not affected with any serious disease of heart, lungs, or brain; loosen clothing about neck and chest; remove artificial teeth, if any are worn.

Q. What inhaling apparatus is necessary.

A. Sponge, napkin, or handkerchief, placed inside a cone made of stiff paper or formed of a towel, with small opening at apex for admission of air; or a wad of lint can be held in palm of hand, and anæsthetic poured on these.

Q. How should the inhalation be conducted.

A. Commence cautiously, patient directed to breathe naturally and to banish all fears, and obey such instructions as raising the hand or opening eyelids when desired; the napkin or sponge held three or four inches from face, gradually bringing it closer to prevent irritation of air passages, and patient directed to make full inspirations.

Q. What are the stages of anæsthesia.

A. First, slight relaxation; second, tetanic or convulsive; and third, complete relaxation and unconsciousness.

Q. During a favorable administration what is condition of patient when fully anæstheticised.

A. Face cool; profuse perspiration; eyes closed; insensibility to touch; somewhat contracted pupils; pulse somewhat slower than normal.

Q. What is the order in which the nerve centres are affected by the anæsthetic.

A. Cerebrum, cerebellum, spinal cord, medulla oblongata.

Q. What is the time required for complete anæsthesia.

A. For ether—four to twenty four minutes, average time eight minutes. For chloroform—two and one-half to fifteen minutes, average time seven miuutes.

Q. What are the conditions rendering anæsthesia dangerous.

A. Affections of heart, such as fatty degeneration, valvular lesions; disease of kidneys; tumors of brain; respiratory obstructions, thoracic tumors; hypertrophied tonsils; aneurism of vessels; and chronic alcoholism.

Q. What conditions are to be avoided when giving anæsthetics.

A. Full stomach; empty stomach from long fasting; excitement.

Q. What is the treatment of Dangerous Symptoms.

A. When heart's action is suspended stop administration, place body in a reclining position, if necessary invert body, and admit air freely; the failure of respiration indicates the drawing forward of tongue, and for serious cases the inhala ion, with great care, of two or three drops of nitrate of amyl, also the inhalation of ammonia. Galvanism (the positive pole to nostril and negative pole over diaphragm), and artificial respiration and warmth, with brisk friction upward of extremities.

Fire or light in a room filled with ether vapor, which is heavier than air and very explosive, is dangerous.

Q. What is the value of Nitrous Oxide as a general anæsthetic.

A. Pleasant and safe, transient nature of its effects, no unpleasant after-effects.

Q. What is its disadvantage.

A. The shortness of its anæsthesia.

Q. How is Nitrous Oxide Gas administered.

A. Same care should be observed as with ether or chloroform. Seat patient in a horizontal position in an operating chair with back lowered, dress about throat and waist loose, and no food for two hours before the iuhalation; a rubber mouth-prop placed between teeth to prevent closure of jaws. The patient is then directed to take full, natural and deep inspirations of gas, the nose being held or covered to prevent entrance of air.

Q. What are its effects.

A. Strong, involuntary respirations, with snoring, more or less livid appearance of lips, cheeks and finger nails, and loss of sense of touch.

Q. What is a reliable test for complete anæsthesia.

A. Loss of sensibility to touch in conjunctiva.

Q. What quantity of N. O. Gas is required.

A. Five to fifteen or more gallons.

Q. What are the different stages under N. O. Gas.

A. First stage, muscular activity; second stage, muscular rigidity; it is considered dangerous on account of asphyxia, to carry it to muscular relaxation, hence the necessity for use of mouth-prop.

Q. What is *Bromide of Ethyl*, or *Hydrobromic Ether* $C_2 H_5 Br$.

A. A colorless, volatile fluid with an agreeable odor, somewhat like

ether, and pungent taste; not inflammable or irritant; obtained by distilling bromide of potassium and sulphuric ether with chloride of lime.

Q. What are its medical properties and action.

A. Anæsthetic: Its administration is somewhat dangerous having a poisonous action on centres of respiration; it decreases the heart force.

Q. How is Bromide of Ethyl administered.

A. The same as Ether and Chloroform, one drachm being used at the commencement of the inhalation, and deep, full inspirations taken.

Q. How are the Salts of Cocaine used as local anæsthetic.

A. For extraction of teeth and other dental operations, by hypodermic injection, or by application to gum on either side of the tooth; two or three applications being made at intervals of two minutes. For devitalizing Pulps, the arsenious acid is combined with cocaine; it is also applied to hypersensitive dentine.

Q. What is *Alcohol*, $C_2 H_6 O$.

A. A colorless, inflammable fluid, with pungent odor, and burning taste, soluble in water and ether, and vaporizable by heat, obtained by repeated distillations from fermented grain or starchy substances.

Q. What are its Medical properties and Action.

A. A powerful diffusible stimulant, causing general exhilaration; in large doses depressant, with effects of narcotic poisons resulting in delirium, coma, and death.

Q. What is the composition of commercial Alcohol.

A. Ninety per cent. of absolute alcohol and ten per cent. of water; absolute alcohol is generally ninety-eight per cent. in strength; whiskey (spiritus fermenti) from rye, corn, barley, and potatoes, contains forty-five to fifty per cent of alcohol.

Q. What are its Therapeutic and Dental uses.

A. Stimulant in acute inflammations, acute neuralgias, etc.; in chloroform narcosis whiskey will sustain heart and prolong anæsthesia, also wine in nitrous oxide gas administrations; acts as a styptic by coagulating blood and contracting mouth of vessel; as an antiseptic for suppurating wounds, and as a canal dressing; for softened and sensitive dentine; for drying cavities before filling, absolute alcohol is employed.

Q. What is *Nitrite of Amyl*, $C_5 H_{11} N O_2$.

A. A clear, yellowish, oily liquid, with etheral odor, very volatile and inflammable; insoluble in water; but soluble in alcohol, ether, and chloroform; derived from action of nitric or nitrons acid upon amylic alcohol.

Q. What are its Medical Properties and action.

A. Used by inhalation; causes great activity of heart, dilation of vessels, flushing of face, sense of fullness of brain, and complete resolution of muscular system, and arrests functional activity of muscles; a powerful stimulant of the heart.

Q. What are its Therapeutical and Dental uses.

A. Employed in syncope, chloroform narcosis, epileptic attacks, and other convulsive and spasmodic diseases.

Q. What is the Dose of Nitrite of Amyl.

A. From ij to iij minims.

Q. What is *Myrrh*.

A. A resinous exudation from a small tree of Arabia and Africa; in small

masses of a reddish-yellow color, brittle and translucent, with aromatic taste, and peculiar fragrant odor; very astringent.

Q. What are its Dental uses.

A. In form of tincture, diluted, as a gargle and mouth-wash ; stimulates spongy and inflammed gums ; in alveolar pyorrhœa, in full strength.

Q. What is *Capsicum.*

A. Cayenne Pepper, fruit of a tropical plant ; pungent odor, hot taste ; contains an acrid volatile principle called capsicine.

Q. What are its Medical Properties and Action.

A. A powerful stimulant, causes warmth of stomach and a glow over entire body ; stimulates circulation and digestion ; in excessive doses an irritant poison.

Q. What is the dose of Capsicum.

A. Dose v minims to one drachm, of the tincture ; v grains to x, of the powder.

Q. What are its Dental uses.

A. In form of tincture or plaster in periodontitis; as a stimulating gargle.

Q. What is *Oil of Cloves.*

A. A clear, colorless oil from flowers of an evergreen myrtle of the Indies ; pungent, spicy taste, fragrant odor.

Q. What are its Medical Properties and Action.

A. An aromatic stimulant, and antiseptic ; employed to relieve nausea, and griping, and to modify action of other medicines.

Q. Dose of Oil of Cloves.

A. One to five minims.

Q. What are its Dental uses.

A. To relieve odontalgia by its stimulating effect.

Q. What is *Eugenol.*

A. An active principle of oil of cloves, sometimes called an acid ; a clear, colorless oil, with taste and smell of oil of cloves.

Q. What are its Dental uses.

A. An antiseptic in treatment of putrescent pulps, etc.

Q. What is *Cinchona.*

A. The bark of South American trees of same name, the medicinal properties of which depend upon the alkaloids they contain, at least two per cent. of which is *Quinine.*

Q. What are its Medicinal Properties and Action.

A. The varieties of cinchona are named according to their color—yellow, pale and red, the yellow powder being more bitter and containing more quinine. Cinchona is a bitter tonic, astringent, antiseptic, and antipyretic. The alkaloid quinine is generally employed.

Q. What is the dose of *Cinchona* and *Quinine.*

A. Of powdered Cinchona, ten grains to three drachms; of extract, one to ten grains ; of Sulphate of Quinine, one to twenty grains ; of Sulphate of Cinchonidine, two to thirty grains (half the strength of quinine).

Q. What are the Dental uses of Cinchona and Quinine.

A. As a tonic for neuralgia from malaria ; as an antiseptic and germicide; and as an ingredient of dentifrices for its tonic and antiseptic properties.

Q. What is *Eucalyptus* derived from.

A. The leaves of an Australian tree, but now found in other countries, *Eucalyptus globulus.*

Q. What are the medicinal properties of the leaves due to.

A. A volatile oil—oleum eucalypti—eucalyptol.

Q. What are its Medicinal Properties and Action.

A. It promotes appetite and digestion ; increases heart's action ; it is antiseptic, disinfectant, diaphoretic, and sedative ; and anti-malarial by its emanations.

Q. What are the doses of its preparations.

A. Of Extract—one to fifteen grains; of Fluid extract—twenty minims to one drachm ; of Tincture—one-half to two drachms ; of the Oil—five to twenty minims in emulsion.

Q. What are its Dental uses.

A. As an antiseptic, either alone or combined with iodoform, for putrescent pulps, and alveolar abscess, necrosis and caries of maxillary bones.

Q. What is the derivation of *Iodine*.

A. Principally from Marine Plants.

Q. What are its Properties.

A. Non-metallic, in form of bluish-black crystalline scales of a metallic lustre, peculiar odor, hot acrid taste, and a neutral reaction ; readily soluble in alcohol and ether.

Q. What are the principal preparations and their Doses.

A. Tincture—one to five minims; Compound tincture—one to ten minims, diluted.

Q. What are the Medical Properties and Action of Iodine.

A. In small doses, stimulant and tonic ; locally an irritant, which effect is diminished when it is combined with potassium; hence iodide of potassium is usually employed internally.

Q. What are the Dental uses of Iodine.

A. In form of tincture for periodontitis, affections of gums, fungous growths, putrescent pulps, alveolar abscess ; for periodontitis combined with aconite, and for ulcerations with carbolic acid ; mixed with carbolic acid it is rendered colorless.

Q. What is the derivation of *Iodoform*.

A. From the action of chlorinated lime upon iodide of potassium ; in the form of small yellow crystals of a soft touch, sweetish taste, and unpleasant odor; insoluble in water, but soluble in alcohol, ether, chloroform, and essential oils.

Q. What are its Medical Properties and Action.

A. Antiseptic and Germicide ; tonic, anodyne, alterative ; in large doses poisonous.

Q. What is the dose of Iodoform.

A. One to five grains in pill.

Q. What are its Dental uses.

A. Antiseptic for alveolar abscess, putrescent pulps, pyorrhœa alveolaris, etc., often combined with oil of cloves, and eucalyptus.

Q. What is the derivation of *Iodol*.

A. From action of iodine on certain constituents of animal oil; in the form of a grayish-white powder ; odorless ; slight taste ; soluble in alcohol ether, chloroform, carbolic acid, etc.

Q. What are its Medical Properties and Action.

A. Antiseptic, deodorant, germicide, and an anæsthetic ; its physiological

actions being the same as those of iodoform; used on wounds, ulcers etc.

Q. What are its Dental uses.

A. Same as those of Iodoform.

Q. What is *Aristol* derived from.

A. By adding a solution of iodine in iodide of potassium to a solution of hydrate of sodium containing thymol; a red-brown non-crystallizable powder; insoluble in water and glycerine, but soluble in alcohol, and readily so in chloroform, ether, and essential oils; slight odor of thymol.

Q. What are its Medical Properties and Action.

A. Not irritant or poisonous; an excellent antiseptic in ulcers, abscesses, cutaneous diseases, etc.

Q. What are its Dental uses.

A. As an antiseptic for gangrenous pulps, root-canals, etc., alveolar pyorrhœa, combined with oil of cassia, acute pulpitis; combined with collodion as a pulp-capping material.

Q. In what form is Iron used medicinally.

A. In form of Salts.

Q. What are the Medical Properties and Action of Iron.

A. Salts of iron improve quality of blood; increase the red corpuscles, promote appetite, and improve digestion, being an efficient tonic; large doses cause nausea and act as irritants; their prolonged use in small doses exhaust gastric glands by over stimulation; externally used act as styptics in arresting hemorrhage.

Q. What are the contra-indications.

A. In a case of plethora, especially when hemorrhagic tendency is present.

Q. What are the doses of the Tincture of Chloride of Iron, and Powdered Sulphate.

A. Dose of the Tincture of Chloride of Iron, five to twenty minims; of the Powdered Sulphate, one-half to three grains in pill; the solution of subsulphate of iron is only used externally for its styptic action.

Q. What are its Dental uses.

A. Styptic in hemorrhage from tooth extraction, gums and mucous membrane.

Q. How is *Peroxide of Hydrogen*, $H_2 O_2$, obtained.

A. By combining an extra molecule of oxygen with hydrogen monoxide.

Q. What are its Properties and Actions.

A. Inodorous, colorless, almost tasteless, transparent liquid; antiseptic and disinfectant; internally used for fevers, bronchial affections, phthisis, diptheria, etc., locally for its antiseptic, and pus-destroying property.

Q. What is the Dose of Peroxide of Hydrogen.

A. One-half to two drachms.

Q. What are its Dental uses.

A. As an antiseptic, &c., in alveolar abscess, inflammation and ulceration of mucous membrane, alveolar pyorrhœa, fungous growths, etc.

Q. How is *Permanganate of Potash* ($K_2 Mn_2 O_8$) prepared.

A. By fusing black oxide of manganese with chlorate of potassium and caustic potassa; in form of dark purple crystals, soluble in water; sweetish taste.

Q. What are its Medical Properties and Actions.

A. Internally, stimulant, mild escharotic, and a powerful disinfectant and

deodorizer in abscess, ulcers, caries of bone, cancer, etc. Dose for internal use one-quarter to one grain; for external use one drachm to v-x ounces of water.

Q. What are its Dental uses.

A. For abscesses, diseases of antrum, ulcers of mouth with offensive breath, and fetid discharge, necrosis and caries of maxillary bones.

Q. What is the source of *Aconite.*

A. From root of *Aconitum Napellus,* the active principle being an alkaloid-aconitine.

Q. What are its Medical Properties and Actions.

A. A powerful nervous sedative, and in large doses a poison, depressing heart, respiratory organs and spine; it proves fatal by paralyzing heart and respiration; locally applied, arrests inflammation by paralyzing peripheral ends of nerves and favoring resolution; it limits extent of abscess.

Q. Doses of principal preparations of aconite.

A. Of Extract—one-half to one grain; of Fluid extract—one-quarter to two minims; of Tincture—one-half to four minims; fifteen drops is a poisonous dose.

Q. What are its Dental uses.

A. Internally in chronic cases of neuralgia; locally for alveolar abscess, periodontitis (equal parts of tincture aconite and tincture iodine).

Q. Treatment of Aconite Poisoning.

A. Evacuate stomach; administer stimulants, apply warmth to extremities and maintain recumbent position.

Q. What is the source of *Opium.*

A. Concrete, milky, exudation of capsules of Papaver Somniferum.

Q. In what form does it occur.

A. In brownish masses of a narcotic, earthy odor, and bitter taste.

Q. What are its Medical Properties and Actions.

A. Stimulant, narcotic, anodyne, antispasmodic, and intoxicant; it restrains movements and checks secretions of stomach, and intestinal canal. In moderate doses, stimulates inhibitory nerves of intestine, and in excessive doses paralyzes them.

Q. What is the dose of opium.

A. One-quarter to three grains.

Q. What is *Morphine.*

A. One of the seventeen alkaloids of opium; in form of colorless, flat prisms, odorless, and with a very bitter taste.

Q. What are its Medical Properties and Actions.

A. Hypnotic, narcotic, and anodyne; it primarily affects nervous system; in small doses depresses action of spinal cord; in larger doses stimulates it even to convulsions; hypodermically injected it is less apt to affect appetite and bowels than opium by mouth; it produces a stuporous sleep, with irregular and slow respiration, clammy skin, contracted pupils; in other cases coma-vigil and delirium.

Q. What is the Dose of Morphine.

A. One-twentieth to one-twelfth of a grain.

Q. What are the principal preparations of opium.

A. Pulvus opii-powdered opium. Dose one-sixth to two grains; Tincture of opium, laudanum, dose twenty-five drops or minims, equal to one grain of opium; Camphorated Tincture of opium, Paregoric, Dose, one drachm to

one ounce, for infants five to twenty drops; one-half ounce contains one grain of opium; Dovers Powder, Dose, five to fifteen grains.

Q. What are the Dental uses of Morphine.

A. Anodyne: for pulpitis, ingredient of nerve-paste, for sensitive dentine, neuralgia, etc.

Q. What are the dental uses of Opium.

A. In convulsions of teething; mercurial salivation, periodontitis, inflamed gums and mucous membrane; injections in alveolar abscess; generally used in form of the wine or tincture.

Q. What is *Sulphate of Atropine.*

A. Atropine is one of the two alkaloids of belladonna; obtained by adding mixture of sulphuric acid to etheral solution of atropine; formula C_{17}, H_{23}, N O_3; narcotic, anodyne, stimulant, and antispasmodic—same properties and action as belladonna.

Q. What is the Dose of Sulphate of Atropine.

A. 1-120 to 1-60 of a grain; hypodermically—2 minims to 1-120 grain.

Q. What are its Dental uses.

A. Pain of pulpitis and periodontitis; ingredient of a nerve paste.

Q. What is *Sulphate of Quinine.*

A. Quinia is one of the alkaloids of cinchona; sulphate of quinine is obtained by boiling yellow cinchona bark in hydrochloric acid water; a valuable tonic and antiperiodic, antiseptic and stimulant, in the form of colorless, light silky crystals soluble in alcohol and ether, and also in sulphuric acid water; very bitter, and inodorous.

Q. What are its Dental uses.

A. In Periodontitis, facial neuralgia, especially of malarial origin, cancrum-oris, apthous ulcerations; as an ingredient of dentifrices.

Q. What are the symptoms of Cinchonism from large doses of quinine.

A. Fullness and constriction of head, cerebral anæmia, pallor, tinnitus aurium, vertigo, staggering, amaurosis and deafness, dilated pupils, delirium, coma, and in animals convulsions.

Q. What is the treatment.

A. Purge, brandy, hot coffee, or dose of ergot.

Q. What are the principal *Zinc Salts.*

A. Chloride, sulphate, acetate, and oxide.

Q. What are their Medical Properties and Actions.

A. In small doses tonic and astringent, in larger doses emetic, and in still larger corrosive poisons.

Q. What is *Sulphate of Zinc.*

A. A specific emetic acting with little depression.

Q. What is *Chloride of Zinc.*

A. A powerful escharotic; also a deodorized and disinfectant; it promotes healthly granulations applied to indolent ulcers, distroys diseased tissue and promotes healthy action in adjacent parts.

Q What are its Dental uses.

A. Obtunding sensitive dentine, styptic for superficial hemorrhage from gums and mucous membrane, injection for chronic alveolar abscess, and diseases of antrum; also to arrest recession of gum and absorption of alveolar process; in solution it is one of the ingredients of oxychloride of zinc filling material.

Q. What is *Oxide of Zinc.*

A. Tonic and antispasmodic, large doses causing vomiting and purging ; on an empty stomach causes nausea.

Q. What are its Dental uses.

A. Internally for convulsions of dentition in doses one-half to five grains ; locally as one of the ingredients of zinc filling materials, combined with chloride of zinc solution, and with glacial phosphoric acid—the latter known as oxyphosphate of zinc ; combined with carbolic acid for capping pulps.

Q. What is *Iodide of Zinc.*

A. A local stimulant and escharotic ; internally tonic, astringent, and antispasmodic in doses of one to five grains, in form of syrup.

Q. What are its Dental uses.

A. Locally for alveolar pyorrhœa in connection with peroxide of hydrogen, also in tumors of mouth, enlargement of tonsils, chronic abscesses.

Q. What is *Sulphate of Zinc.*

A. Tonic, astringent and antispasmodic, in doses of one-fourth to six grains the latter being the emetic dose.

Q. What are its Dental uses.

A. Externally in gangrene of mouth, diseases of antrum, ulcerations of mucous membrane, and indolent ulcers.

Q. What is *Aromatic Sulphuric Acid.*

A. Elixir of Vitriol—sulphuric acid, alcohol, ginger and cinnamon.

Q. What are its Medical Properties and Actions.

A. Tonic and astringent, stimulates to healthy action, Dose : five to thirty minims. Used in hemorrhages of lungs, etc., debility, night sweats, convalescence from fevers, dysentery, etc. Externally : applied to carious bone, ulcers, necrosis, chronic alveolar abscesses, cancrum oris, stomatitis (largely diluted).

Q. What is *Nitric Acid.*

A. Aqua fortis—sulphuric acid acting upon nitrate of potash or soda ; a powerful caustic and escharotic ; colorless when pure, emitting acrid, corrosive fumes. Diluted form, ten per cent. absolute alcohol, is used internally as a tonic and refrigerant. Dose of diluted acid two to fifteen drops in water.

Q. What are the Dental uses of Nitric Acid.

A. As a caustic for devitalizing pulps of teeth, malignant ulcers of month, cancrum oris.

Q. What is *Bichloride of Mercury, Mercuric Chloride,* $Hg\ Cl_2$.

A. Corrosive Sublimate—one of the products of the distillation of a sodium chloride and mercuric sulphate (the other product being sodium sulphate) in the form of colorless crystalline masses, inodorous, acrid, styptic taste, fusible, soluble in sixteen parts of water, seven parts of alcohol and ether.

Q. What are its Medical Properties and Actions.

A. One of the most efficient and active salts of mercury ; internally employed in dysentery, chronic diarrhœa, syphilis, skin diseases, etc. Externally as an antiseptic or antizymotic, disinfectant and germicide, or bactericide, it has scarcely any superior ; it is a corrosive poison and great care is necessary in its use. Dose internally, one-thirtieth to one-tenth of a grain in pill.

Q. What are the antidotes.

A. Albumen, wheat-flour, milk.

Q. What are its Dental uses.

A. For alveolar abscess, disinfecting root canals, putrescent pulps, diseases of antrum, etc.

Q. In what strength is it safe to use its solutions.

A. One to five thousand of water, to one to two thousand, the latter with care.

Q. What is the difference between calomel and corrosive sublimate.

A. Calomel is mild chloride of mercury, Hg Cl; Corrosive Sublimate is $Hg\ Cl_2$.

Q. What is *Nitrate of Silver*, $Ag\ No_3$.

A. Lunar caustic—obtained by dissolving silver in nitric acid; in form of colorless shining crystals, soluble in water, and of a metallic styptic taste.

Q. What are its Medical Properties and Actions.

A. Powerfully caustic and astringent, a stimulant of heart and nerves, sedative, and antispasmodic.

Q. What is the Dose.

A. One-sixth of a grain, gradually increased to one grain in pill.

Q. What is the antidote.

A. Common salt—chloride of sodium.

Q. What are its antagonists.

A. Tannic acid, and vegetable extracts.

Q. What are its Dental uses.

A. Styptic, although the clot from it is soluble in albumen; obtunder of hypersensitive dentine (applied in stick form, or by dipping end of silver wire in nitric acid), especially when it is due to abrasion; ulcerated mucous membrane, etc.

Q. What is the effect when it is applied to mucous membrane.

A. First it whitens the surface by combining with coagulated albumen, but finally blackens it, owing to the partial reduction of the silver by sulphuretted hydrogen of atmosphere.

Q. What is *Hydrochloric Acid*, H Cl.

A. Muriatic acid—colorless when pure, yellow on exposure; caustic taste; volatile, with a dense white, suffocating vapor.

Q. What are its Medical Properties and Actions.

A. Caustic, escharotic, and disinfectant; the diluted acid for internal use, is tonic, refrigerant, and astringent.

Q. What is the dose of Diluted Hydrochloric acid.

A. Dose five to twenty minims.

Q. What are its Dental uses,

A. For inflamed and ulcerated mucous membrane and gums; in Laboratory as a flux in soldering.

Q. What is *Pepsin*.

A. An organic ferment which forms digestive principle of gastric juice; usually obtained from mucous membrane of pigs stomach, or from calf and sheep.

Q. Medical Properties and Action.

A. It digests nitrogenous principles of food (albumen, casein, fibrin, etc.,) converting them into peptones for assimilation, aided by lactic acid.

Q. What are its Dental uses.

A. For putrid pulps; and combined with hydrochloric acid for devitalizing pulps.

Q. What is *Thymol* obtained from.

A From volatile oils of Thymus vulgaris; in form of large prismatic white crystals; odor of thyme; pungent aromatic flavor.

Q. Medical Properties and Actions.

A. Acrid properties similar to carbolic acid, and like it combines with animal tissue and prevents putrefaction; externally antiseptic, and antiferment

Q. What are its Dental uses.

A. Combined with glycerine in form of *Glycorole* of *Thymol*, is a valuable antiseptic for putrescent pulps, ulcers of mouth, wounds, etc., also to arrest putrefactive process in chronic pulpitis, alveolar abscesses, also in stomatitis.

Q. What is *Menthol*.

A. Peppermint Camphor, obtained by cooling the oil distilled from the herb of *mentha arvensis* and *mentha piperita*; in colorless crystals with taste and smell of peppermint, soluble in alcohol and ether.

Q. What are its Medical Properties and Actions.

A. Anodyne, antiseptic and antispasmodic.

Q. What is the Dose.

A. One-tenth to one-sixth of a grain.

Q. What are its Dental uses.

A. Facial neuralgia, odontalgia, sensitive dentine, decomposing pulps, necrosed teeth, root-canals, etc.—used externally.

Q. What is *Chloro-Phenique*, $C_6 H_4$ (O. H.) Cl.

A. A nearly saturated aqueous solution of chloro-phenic acid combined with antiseptic essential oils.

Q. What are its Medical Properties and Actions.

A. Non-poisonous, non-irritant, antiseptic, with antizymotic and germicidal properties eqivalent to those of a 20 per cent-solution of carbonic acid.

Q. What are its Dental uses.

A. For catarrhal inflammation of mouth, alveolar pyorrhœa, menstruum in devitalizing paste, pulp canals for putrescent pulps, early stages of periodontitis, etc.

Q. How do the *Volatile* or *Essential Oils* differ from Fixed Oils.

A. The essential oils are composed of carbon and hydrogen : the fixed oils are compounds of carbon, hydrogen, and oxygen.

Q. Name some of the Essential Oils which are obtunders of sensitive dentine and antiseptics.

A. Oils of peppermint, cloves, caraway, cajeput, mustard, and turpentine, cassia, cinnamon, thyme, eugenol, eucalyptol, peppermint, caraway, mustard, wintergreen.

Q. What is Dr. Black's dressing for putrid pulp-canals and abscesses.

A. Oil of cassia, 2 parts; oil of wintergreen, 3 parts; mix and add carbolic acid (melted crystals), 1 part; known as 1, 2, 3 mixture.

Q. What other combination is used for same affections.

A. Eugenol, or oil of cloves, and iodoform.

CHEMISTRY.

Q. What does chemistry investigate.

A. Composition of substances around us, changes in them, and laws that govern these changes.

Q. Into what are all substances chemically divided.

A. Into compound substances and simple elements.

Q. Describe each.

A. Compound: Those which can be broken up into simpler substances, a H_2O into H and O; Simple: Substances which cannot be broken up into anything more simple, as H. O. N. C. S., etc.

Q. What properties has an acid.

A. Acrid or sour taste when dissolved in H_2O; changes color of organic substances, as litmus from blue to red; contains H, which can be replaced by metals a salt being formed.

Q. What properties has an alkali.

A. Directly opposite those of an acid, taste of lye, changes red litmus to blue; acted on by acids from salts.

Q. What is an alkaloid.

A. A vegetable alkali; the active principle of drugs, and on it the activity depends.

Q. What is dialysis.

A. The power certain substances have of dialyzing or passing through moist membrane.

Q. What are colloids.

A Substances that will not pass through moist membrane.

Q. What are crystalloids.

A. Substances that dialyze rapidly, and assume shape of crystals.

Q. What is an anhydride.

A. A substance which forms an acid when dissolved in H_2O. as $CO_2 + H_2O = H_2CO_3$ carbonic acid.

Q. What is meant by a chemical equation.

A. A collection of formulæ, signs, and symbols, and implies that a chemical action is to take place, or has taken place.

Q. Examine following equations and if any errors correct them.

$CaCO_3 = CaO + CO$.

$NaOH + HCl = NaCl + H_2O$.

$Fe + 2HCl = FeCl + H$.

$2NaCl + H_2SO_4 = Na_2SO_4 + HCl$.

A. All are correct.

Q. What is meant by chemical action.

A. Action or force which takes place between chemical substances—called chemism or chemical affinity,

Q. Difference between a chemical element and a compound.

A. First, is a substance which cannot be reduced any lower, a simple substance; second, is one which can be reduced into its compound parts—made up of two or more substances.

Q. What is Atomic Weight.

A. The weight of an atom or substance as compared to the weight of some atom taken as a standard. The atom of H is lightest and is used as a standard.

Q. What is a Molecular Weight.

A. The sum of the addition of weights of all the actions of the several elements which have united to form a compound body.

Q. What is meant by calling chlorine a monad, oxygen a dyad, nitrogen a triad, and carbon a tetrad.

A. Elements combine in different proportions; this is called quantivalence or valence or atonicity; it is the power of attraction which atoms of elements have of attracting and holding in combination 1, 2, 3 or 4 atoms of some other element; H is used as the standard, and combining power of atoms compared with combining power of atoms of H, gives the valence of the element. Those having combining power of one, as Cl, as compared with atoms of H, are called Monads; those having combining power of two, as O, are called dyads; those of three, as N, triads; those of four, as C. tetrads.

Q. Explain difference between atomic and molecular formulæ, with examples.

A. Atomic is the number of atoms in an element; this collection is written at the right and a little below as H_2, being 2 atoms of H. Molecular is the number of molecules in an element or compound, and is written just in front, as 4 H_2 O, being 4 molecules of H_2 O.

INORGANIC CHEMISTRY.

OXYGEN AND HYDROGEN.

Q. Describe the leading properties of Oxygen.

A. An inodorless, tasteless gas, only sparingly soluble in H_2 O, has great affinity for nearly all other elements, and combines directly with nearly all substances; it does not combine with flourine; the union of substances with O forms oxicles.

Q. What is the action produced by animals and by plants on the air.

A. Animals breath in O and give off C O_2 to the air. Plants give off O and take in C O_2, so the supply of O is kept up.

Q. What is the composition of Atmosphere.

A. Oxygen 20.60; Nitrogen 77.95; Carbon dioxide .04; Moisture 1.40; Nitric acid and Ammonia, traces. The oxygen supports animal life; nitrogen dilutes the oxygen.

Q. Why is it necessary that the oxygen should be diluted.

A. To prevent too rapid vital or life functions which would soon exhaust and destroy animals.

Q. How does Ozone differ from Oxygen.

A. Ozone is allotropic form of oxygen, made when non-luminous electric discharges pass through air or oxygen; when phosphorous partially covered with H_2 O is exposed to air; also during a number of chemical decompositions. It differs from ordinary oxygen in having a peculiar odor, like wet-matches, by being a stronger oxidizing agent; liberates iodine from potassii iodide; ozone contains three atoms to the molecule; oxygen but two; the three molecules of oxygen are reduced to two when it is changed into ozone, 3 O_2 oxygen $= 2\,O_3$ ozone.

Q. What are Barometers.

A. Instruments to measure pressure of atmosphere.

Q. What is the degree of atmospheric pressure in a glass tube containing fifteen lbs. of mercury, one inch square at base.

A. Fifteen lbs. to the square inch.

Q. What is the principle of the barometer.

A. A glass tube three feet long, closed at one end, is filled partly full of mercury, and inserted in a vessel of mercury, and the mercury column is maintained by the pressure of the atmosphere upon surface of mercury.

Q. What are the properties of Hydrogen.

A. Colorless, inodorless, tasteless gas, lightest of all known substances, having specific gravity of 0.0692 as compared with atmospheric air, burns readily in air, or in pure oxygen, with a non-luminous, colorless or slightly bluish flame.

Q. What is formed when hydrogen is burned air.

A. Water, as it takes one atom of oxygen from the atmosphere.

CHEMICAL CALCULATIONS.

Q. Describe briefly the Metric System.

A. It combines weight, capacity, and distance. The metre is the unit of length and starting place for whole system. It is one-tenth—within distance of equator to the pole; it is 39.1 inches long. This is a decimal system. Less than the metre, the Latin prefixes are used; above the metre, Greek prefixes.

1-10 metre = 1 decimetre.	10 metres = 1 decometre.
1-100 " = 1 centimetre.	100 " = 1 hectometre.
1-1000 " = 1 millimetre.	1000 " = 1 kilometre.

This applies to distance only. A cube 1 decimetre is unit of capacity and is called Litre; it is about one quart.

Latin prefixes below the litre, Greek above.

1-10 litre = 1 decilitre.	10 litres = 1 decolitre.
1-100 " = 1 centilitre.	100 " = 1 heclolitre.
1-1000 " = 1 millitre.	1000 " = 1 kilolitre.

One cube one centimetre of distilled water at its greatest density 4° centigrade, is the unit of weight, and called a gramme.

Below the gramme Latin, and above Greek prefixes.

1-10 gramme = 1 decigramme.	10 grammes = 1 decogramme.
1.100 " = 1 centigramme.	100 " = 1 hectogramme.
1-000 " = 1 milligramme.	1000 " = 1 killogramme.

The gramme weighs about fifteen and one-half grains.

Q. How is a Thermometer graduated.

A. The bulb end is heated, so that a portion of air is expanded and forced out, and then placed in a jar of mercury; the air cooling will contract, and a portion of mercury is drawn in; the bulb is again heated, when vapor of mercury will fill tube and force out nearly all the air; the bulb being shaken a drop of mercury will fall into tube, and another heating will fill both tube and bulb with vapor of mercury, and while hot the open end of tube is sealed up, leaving a vacuum. To graduate, it is placed in melting ice, and the point at which mercury stands is marked; this gives freezing point; it is then placed in escaping steam, and mercury point marked, which gives boiling point; having these two points the scale is made between them by marking at equal distances points called degrees.

Q. Describe the three thermometric scales in use.

A. Fahrenheit, Centigrade, and Reaumur's. Fahrenheit Zero is obtained from intense cold of ice and salt mixture, freezing point falling 32°, boiling point 212°. Centigrade has freezing point for zero, boiling point falls at 100°. Reaumur's freezing point at zero and boiling point at 80°.

Q. What are the laws of gaseous diffusion.

A. The volume of a gas is inversely as the pressure; density and elastic force directly as the pressure, and inversely as the volume; a gas is a vacuum for every other gas; the gaseous state is the one which differs the most; all gases expand or contract when temperature is raised or lowered an equal number of degrees.

WATER.

Q. What is meant by latent heat of water.

A. Heat not indicated by thermometer; latent heat is necessary to convert solids into liquids, and liquids into gases, and is not indicated by thermometer.

Q. Describe changes in bulk which water undergoes when heated from 0° to 100°.

A. Water is at its greatest density at 38° F. 4° C. above and below that it expands.

Q. When does water boil.

A. At 212° F; 100° C; 80° Reaumur.

Q. How is pure water obtained.

A. Pure H_2O is obtained by distillation which is conversion of water into gas, and it then boils into a liquid. Rain water is the purest natural water, and the purest form of it is that collected after a rain of several days duration.

Q. What is composition and chief properties of hydrogen dioxide or peroxide.

A. Thick, colorless, oily liquid, odor like diluted Cl. and metallic, astringent taste. It is compound of two atoms of H to two atoms of O H_2O_2.

NITROGEN.

Q. Describe the preparation of Nitrogen Gas.

A. By burning phosphorous in a closed space over water; by passing air over red hot copper, oxygen of air unites with the copper forming oxides of copper, nitrogen being set free; by passing chlorine gas through ammonia.

Q. What are the properties of Nitrogen.

A. A colorless, tasteless, inodorless gas, not inflammable, will not support life or light, but is harmless and inert, lighter than air, a little lighter than oxygen; intense cold and great pressure will reduce it to a clear, colorless liquid.

Q. Give composition of five oxides of nitrogen.

A. N_2O. Nitrous oxide; N_2O_2, or N. O. nitric oxide; N_2O_3, nitrogen tetroxide; N_2O_5, nitrogen pentoxide.

Q. What is chemical combination in multiple proportions.

A. If two elements A. and B. are capable of uniting in several proportions, the quantities of B, while combining a fixed quantity of Bi., bear simple ratio to each other.

Q. Write out in symbols, decomposition occuring in preparation of nitric acid., and meaning of the symbols.

A. The salt Nitrite of Sodium is acted on by sulphuric acid, one or two

atoms of the nitrite can be used, as $Na\ N\ O_2 + H_2\ S\ O_4 = H\ N\ O_3 + Na\ H\ O_4$; or $2\ Na\ N\ O_3 + H_2\ S\ O_4 = 2\ H\ N\ O_3 + Na\ 2\ S\ O_4$. The first gives one molecule $H\ N\ O_3$ and Sodium Bisulphate, the latter two molecules of $H\ N\ O_3$ and sulphate of sodium $Na_2\ S\ O_4$.

Q. Give tests for Nitric acid.

A. When heated with copper filings and sulphuric acid, evolves red fumes of nitrogen tetroxide; a solution of indigo is decolorized by nitric acid.

Q. Name chief properties of Nitrous Oxide gas.

A. Colorless, little odor, sweet taste, supports combustion almost as well as oxygen; inhaled, it causes exhileration, intoxication, anæsthesia; used in dentistry as an anæsthetic.

Q. What is relation between nitrogen pentoxide and nitrates trioxide and nitrites.

A. The first contains $N_2\ O_5$, two atoms of N. to five of O; the trioxide contains two atoms of N to three of O. $N_2\ O_3$; the tetroxide $N_2\ O_4$, two atoms of N. to four of O; nitrogen dioxide $N_2\ O_2$ or N. O. contains equal volumes of N. and O; nitrogen minoxide, or nitrous oxide, N_2 O. contains two atoms of N to one of O.

Q. How is Nitrous Dioxide (nitric oxide) prepared.

A. By extracting nitrogen from same substances as nitric acid which contains it. $3\ Cu + 8\ H\ N\ O_3 = Cu\ (N\ O_3 + 4\ H_2\ O + 2\ N\ O.$

Q. What is the difference between nitrous oxide and nitric oxide.

A. Nitrous oxide contains one atom less of oxygen, $N_2\ O_2$—Nitric oxide; N_2 O—Nitrous oxide.

Q. By what two methods can ammonia be prepared.

A. First, by passing an electric discharge for many hours through mixture of one volume of nitrogen to three of hydrogen (difficult). Second, by treating ammonia from gas works (a sulphide); with calcium hydroxide.

Q. What are the properties of ammoniacal gas.

A. Colorless, very pungent odor, alkaline taste, strong alkaline reaction; burns in pure oxygen forming water and free oxygen.

Q. How may ammonia be frozen.

A. By mere application of seven atmospheres, or by intense cold can be converted into a liquid, which at 80° C. or 112° F. forms a solid crystalline mass.

Q. How is Liquid Nitrous Oxide prepared.

A. By treating the gas under a pressure of fifty atmospheres, when it is converted into a colorless liquid.

CARBON.

Q. Name the three distinct forms in which carbon exists.

A. Diamond, graphite, and amorphous, as coal, lamp-black, bone-black and charcoal.

Q. State their peculiarities.

A. Diamond is purest form of carbon, very hard and very valuable; graphite is a somewhat rare, dark-gray mineral; amorphous is of soft, black consistency.

Q. Carbon combining with oxygen, hydrogen, and nitrogen, forms compounds which form a separate branch of chemistry.

A. Carbon combining with O. N. and H. forms hydro-carbons, which form Organic Chemistry.

Q. Describe nature of diamond.

A. Crystallizes in regular octahedrons, cubes , or in some figure intimately connected with these ; hardest known substance; infusible, but burns when heated intensely, forming CO_2.

Q. Describe nature of graphite.

A. Graphite, plumbago, or black-lead, is carbon crystallized in short six sided prisms, somewhat rare, of a dark-gray color, used principally for lead pencils, solder supports, etc.

Q. What changes occur in passage of wood into charcoal.

A. Charcoal is obtained by heating or burning wood out of contact with air ; it contains hydrogen and mineral substances of wood, and has lost carbon by burning.

Q. Describe source and nature of coal.

A. Formed from vegetable matter by a slow process of decay, mostly under water, in which hydrogen and oxygen are in great part removed, and the carbon by pressure made compact, the decay being partly a fermentation and partly a decay, and chiefly slow destructive distillation; of hard, brittle consistence, black color ; it is an impure form of carbon.

Q. How many compounds does carbon form with oxygen, and what are they.

A. Two, carbon dioxide CO_2, and carbon monoxide C. O.

Q. How may carbonic acid gas (carbon dioxide), be generated.

A. By burning carbonate of lime $CaCO_3$ (lime-stone); $CaCO_3$ acted on by HCl will give carbon dioxide.

Q. What are its properties.

A. CO_2 is a colorless, odorless gas, with faintly acid taste ; is not a poison in itself, but will cause death by arresting respiration.

Q. What law regulates absorption of this gas in water.

A. Cold water absorbs about its own volume, and under great pressure a a large amount is absorbed in the water.

Q. How can carbonic acid be obtained in liquid and solid states.

A. By pressure of thirty-eight atmospheres at temperature of 32° F. or 0° C. it is converted into a colorless liquid, which, by intense cold, becomes a solid, crystalline, snow like substance.

Q. How is carbon monoxide, or carbonic oxide gas formed.

A. When carbon is burned in an insufficient supply of oxygen; by passing CO_2 over red hot carbon one atom of oxygen will be removed, $CO_2 + C = 2CO$; or carbonate of calcium $CaCO_3$, heated with some form of C. $CaCo_3 + C = CaO + 2CO$.

Q. In what forms are compounds of carbon with hydrogen known.

A. Hydrocarbons, very numerous.

Q. What are Marsh gas (methane CH_4), and Fire-damp, Ethene C_2H_4.

A. Hydrocarbons.

Q. How is Acetylene formed.

A. When electric sparks pass between electrodes of carbon in an atmosphere of hydrogen,

Q. How is Ethene (heavy carburetted hydrogen, or olefiant gas) formed.

A. By destructive distillation of organic substances.

Q. What are its properties.

A. A colorless, almost odorless gas.

Q. Describe the structure of a Flame.

A. Consists of three parts or cones the inner or central is unburnt gas; the second, partially burnt and burning gas; the outer cone, showing highest temperature, but scarcely any light, is where complete combustion takes place.

Q. Describe principle of a Bunsen Burner

A. One in which enough air is admitted to flame to produce complete combustion; no light, but intense heat is produced.

Q. What is Cyanogen Compound.

A. Does not occur itself in nature, but compounds of it are found when organic matter containing nitrogen are heated with an alkali, especially in presence of iron.

Q. What is most important compound formed by cyanogen with hydrogen.

A. Hydrocyanic acid.

Q. How is cyanogen gas formed.

A. By heating cyanide of mercury $Hg\ (Cn)_2 = Hg + Cn$.

Q. What are its properties.

A. A colorless, transparent gas, with peculiar odor, very soluble in $H_2\ O$., heavier than air, can be collected by displacement, acts as chlorine.

CHLORINE.

Q. How is Chlorine prepared.

A. By acting on sodium chloride with sulphuric acid, and treating the hydrochloric acid formed with manganese.

Q. What are the properties of chlorine.

A. A greenish-yellow gas, very disagreeable odor irritating to fauces, two and one-half times heavier than air; under pressure of 45.50 lbs. to square inch, and cooled by salt and ice mixture, it can be reduced to a greenish-yellow liquid.

Q. Combining with hydrogen, chlorine forms what acid.

A. Hydrochloric, H Cl.

Q. Upon what does the bleaching power of chlorine depend.

A. The presence of moisture; the chlorine liberates the oxygen from the moisture, and it is the liberated oxygen that bleaches.

Q. Does dry chlorine gas bleach.

A. No.

Q. What is composition of bleaching powder.

A. For convenience chlorine is passed through slaked lime; called chloride of lime or calcium hypochlorite $Ca\ (Cl\ O)_2$.

Q. Give formulæ of oxides of chlorine and corresponding acids.

A. Hypochlorous oxide, $Cl_2\ O + H_2\ O = 2\ H\ Cl\ O$.

Chlorous oxicle, $Cl_2\ O_3 + H_2\ O = 2\ H\ Cl\ O_2$.

Chlorous tetroxide, $Cl_2\ O_4$, does not contain water to form an acid.

Chloric oxide, $Cl_2\ O_5 + H_2\ O = 2\ H\ Cl\ O_3$. Not known in separate state but combined with water.

Per chloric oxide, $Cl_2\ O_7 + H_2\ O = 2\ H\ Cl\ O_4$.

H Cl., Hydrochloric acid.

H Cl O., Hypochlorous acid.

H Cl O_2., Chlorous acid.

H Cl O_3., Chloric acid.

H Cl O_4., Perchloric acid.

Q. Give preparation of Nitro-Hydrochloric acid (Aqua Regia).

A. Obtained by mixing four pints nitric with fifteen pints hydrochloric acid; the two act chemically on each other.

Q. What are the properties of Aqua Regia.

A. Noted for its dissolving power on gold and platinum, which depends on action of free chlorine, and chlorinous gas, which parts easily with its chlorine.

Q. How do chlorine and oxygen unite.

A. Not directly but may be made to unite indirectly.

BROMINE.

Q. How is Bromine obtained.

A. Found in sea water as magnesium bromide, which yields bromine when treated with chlorine, $Mg\ Br_2 + Cl = Mg\ Cl_2 + 2\ Br$.

Q. What are its properties.

A. At common temperature, a dark reddish-brown liquid giving off brown fumes of exceedingly suffocating and irritating odor; very volatile, and sparingly soluble in H_2O; strong disinfectant, and its aqueous solution is a bleaching agent.

Q. What is composition of Bromine and Hydrobromic acids.

A. Bromic acid—$H\ Br\ O_3$; Hydrobromic—$H\ Br$.

Q. What are the oxides and oxy-acids of bromine analogous to.

A. To those of chlorine.

Q. What are the acids of Bromine.

A. Hydrobromic, $H\ Br$., Hypobromic, $H\ Br\ O$., and Bromic acid; $H\ Br\ O_3$.

Q. How is Iodine obtained.

A. In nature in combination with sodium and potassium, in some spring waters, and from sea water; chiefly derived from vitrified ashes of sea weed, known as kelp; washing, evaporating, and crystallizing and treating with manganese dioxide, and hydrochloric or sulphuric acid.

Q. What are its properties.

A. Heavy, bluish-black, crystalline substance, sharp, and acrid metallic taste and lustre, neutral reaction, sparingly soluble in water, stains skin brown, and internally is an irritant poison.

Q. Give equation of the decomposition occuring in its manufacture from potassium iodide.

A. $Ki + Cl = K\ Cl + I$. This occurs when Chlorine acts in potassium iodide. Sulphuric acid may also be used with manganese dioxide. $2\ K\ I + Mn\ O_2 + 2\ H_2\ S\ O_4 = K_2\ S\ O_4 + Mn\ S\ O_4 + 2\ H_2\ O + 2\ I$.

Q. How is hydriodic acid gas obtained and what are its properties.

A. By action of hydro-sulphuric acid used upon iodine in presence of water $H_2\ S + 2\ I = 2\ H\ I + S$. Its salts are used in medicine; a colorless gas, very soluble in water.

Q. Give source of Fluorine.

A. Found in nature as fluorspar, calcium fluoride, traces of it in many minerals, some waters, enamel of teeth and bones of mammals.

Q. What are its properties.

A. A colorless gas, highly irritating and suffocating odor, with affinities stronger than any other element, combines with every element except oxygen, has great affinity for vessels in which it is made.

Q. What general relations do the four elements chlorine, bromine, iodine and fluorine exhibit among themselves.

A. A natural growth of elements, known as haloids or halogens; all combine with hydrogen forming H F; H Cl; H Br; and H I; combine directly with most metals forming fluorides, chlorides, bromides and iodides; with exception of fluorine, they have a distinct color in gaseous state, a disagreeable odor, and disinfecting properties; relative combining energy lessens as atomic weight increases; fluorine with lowest has greatest volume, and with highest atomic weight the smallest affinity for other elements.

Q. How is Hydrofluoric acid obtained.

A. By action of sulphuric acid on fluorspar; used in gaseous state or in solution in water, in etching glass.

Q. How is Sulphur obtained.

A. Found in uncombined state in volcanic districts; in combination with other elements in form of sulphates (gypsum $Ca\ S\ O_4$; $2\ H_2\ O$), and frequently as sulphides (in pyrites $Fe\ S_2$; galena $Pb\ S$; cinnabar $Hy\ S$. etc). Sulphur also enters into organic compounds during decomposition of which sulphur is evolved as sulphurretted hydrogen, which gas is also a constituent of some waters; also crude sulphur. Sublimed sulphur (flower of sulphur) by heating sulphur to boiling point, and depositing vapor in form of a powder of small crystals; washed sulphur, sulphur totum, is washed with very dilute ammonia water, and then with pure water, to free the sulphur from all sulphuric and sulphurous acids; precipitated sulphur (milk of sulphur) made by boiling hydrate of calcium with sulphur and water, filtering, and adding hydrochloric acid, washing and drying the precipitated sulphur.

Q. Give names and symbols of compounds of sulphur, oxygen and hydrogen.

A. Sulphurous acid $H_2\ S\ O_3$, and sulphuric acid $H_2\ S\ O_4$.

Q. How is sulphur dioxide prepared.

A. By action of strong sulphuric acid on many metals (Cu. Hg. Ag. etc.,) $2\ H_2\ S\ O_4 + Cu = Cu\ S\ O_4 + 2\ H_2\ O + S\ O_2$, always formed when sulphur is burned in air.

Q. What are its properties.

A. Colorless gas, suffocating, disagreeable odor, very soluble in water, forming sulphurous acid; a strong deoxodizing, bleaching, and disinfecting agent; poisonous when inhaled in a pure state; diluted with air irritates air passages and causes coughing.

Q. Sulphurous acid is the hydrogen salt of what compounds.

A. Sulphates.

Q. How does bleaching action of sulphurous acid differ from that of chlorine.

A. Chlorine bleaches only in presence of moisture and destroys colors entirely; sulphurous acid bleaches of itself, but colors return by adding weak solution of ammonia.

Q. In what respect are sulphurous and carbonic acids similar.

A. Both extinguish flame of candle.

Q. How may true sulphurous acid be formed from sulphur dioxide.

A. By treating it with water, as in $H_2\ O + S\ O_2 = H_2\ S\ O_3$.

Q. What are, salts called sulphites,

A. Those formed by action of sulphurous acid on substances.

Q. How is sulphuric acid prepared.

A. By passing into large chambers simultaneonsly vapors of sulphur dioxide,

nitric acid and steam, with atmospheric air; oxygen of nitric acid oxidizes the sulphur dioxide, which at same time takes up water $S O_2 + O + H_2 O = H_2 S O_4$; as formed by action of nitric acid on sulphurous acid, $3 H_2 S O_3 + 2 H N O_3 = 3 H_2 S O_4 + H_2 O + 2 N O$.

Q. What are the properties of Sulphuric acid.

A. Colorless, oily liquid, tending to combine with $H_2 O$, absorbing it rapidly from atmosphere; when $H_2 O$ is mixed with $H_2 S O_4$, heat is generated; acts energetically on organic matter removing the H and O. combining them into $H_2 O$, with which it unites, leaving both so rich in carbon that the black color predominates; so strong an acid as to displace most other acids.

Q. How may presence of sulphuric acid be detected.

A. By its changing and blackening again organic substances; sodium sulphate may be used $Na_2 S O_4$; barium chloride produces a white precipitate of barium sulphate, insoluble in acids, $Na_2 S O_4 + Ba Cl_2 = Ba S O_4 + 2 Na Cl$.

Q. How may Thiosulphuric acid be obtained.

A. Not known in separate state, as it decomposes into sulphuric and sulphurous acids when attempts are made to liberate it from its salts, some of which are used, as sodium thiosulphate $No_2 S_2 O_3$. This is the sodium hyposulphite of the W. S. P.

Q. How is Hyposulphurous acid formed.

A. $H_2 S O_2$ by action of sulphurous acid on zinc, $H_2 S O_3 + Zn = Zn O + H_2 S O_2$.

Q. What are the principal compounds of sulphur, hydrogen, and oxygen.

A. Hyposulphurous acid, $H_2 S_2$; fuming sulphuric acid $H_2 S_2 O_3$; dithonic acid, $H_2 S_2 O_6$; tuthenic acid, $H_2 S_2 O_6$; tetrathenic acid, $H_2 S_4 O_6$; pentathianic acid $H_2 S_5 O_6$.

Q. How is Sulphuretted hydrogen formed.

A. By action of sulphuric acid on ferrous sulphide Fe S. $Fe S + H_2 S O_4 = Fe S O_4 + H_2 S$; it is liberated by decomposition of organic matter (putrefaction), and as a constituent of some spring waters; also formed by destructive distillation of organic matter containing sulphur.

Q. What are its properties.

A. A colorless gas, very offensive odor, disgusting taste, very soluble in water, highly combustible in air, burning with a blue flame, poisonous when inhaled.

Q. How may this gas be used for separation of metals into groups.

A. Dissolved in water, used as a reagent for precipitating and recognizing metals, a use which depends on the property of the sulphur to combine with many metals to form insoluble compounds. $Cu S O_4 + H_2 S = Cu + H_2 S O_4$.

Q. Where is Selenium obtained.

A. Found native, also in combination, forming selenides; rare; has several allotropic forms; its power of conducting electricity is affected by light; resembles sulphur in its properties.

Q. Where is Tellurium found.

A. Native, and also in union with bismuth, gold, etc., rare; has a metallic lustre, purplish color, fuses below red-heat, and boils at a somewhat higher temperature; resembles sulphur in its properties.

Q. Where is Silicon found.

A. In nature, very abundant as silicon dioxide or silicon, $Si O_2$ (rock crystal,

quartz, agate, sand), and in form of silicates, which are granite, porphyry, basalt, fieldspar, mica, etc.), or a mixture of them; very much resembles carbon; insoluble, infusible in all common solvents.

Q. Where is Boron found.

A. In but few places, either as boric or boracic acid, or borate of sodium (borax); in nature combined with sodium, and oxygen as borax, $N_2 B_4 O_7 + 10 H_2 O$.

Q. How is crystallized boron prepared, and what are its properties.

A. By action of aluminum; in boric anhydride $B_2 O_3$, if pure in brilliant crystals closely resembling the diamond, and next to it in hardness.

Q. Where does boric or boracic acid occur, and how obtained from borax.

A. $H_3 B O_3$ exists in steam jets discharged in some volcanic regions, and some of its salts occur as minerals; prepared by dissolving borax in warm dilute sulphuric acid and allowing solution to cool.

Q. With what is phosphorous found in combination.

A. Chiefly in nature in form of phosphates of calcium, iron, and aluminum; in small quantities in all soils on which plants will grow.

Q. How is it prepared from bone ash.

A. Bones deprived of animal matter, the bone ash is treated with sulphuric acid, the liquid concentrated, mixed with charcoal and sand, and heated; calcium is then formed, the charcoal takes the oxygen and the phosphorous distils over. $Ca_3 (P O_4) + 2 H_2 S O_4 = 2 Ca S O_4 + Ca H_4 (P O_4)_2$. calcium acid phosphate, $Ca H_4 (P O_4)_2 + Si O_2 + C_5 = Ca Si O_3 + 2 H_2 O + 5 C O P_2$.

Q. What are the properties of Phosphorous.

A. When recent, a colorless, nearly transparent solid, soft as wax; exposed to light, it becomes brownish, opaque, and harder, takes fire easily, usually kept under water, burns with bright flame, causing white clouds of phosphoric anhydride; extremely poisonous, less than ¼ grain has caused death; used as a medicinal substance, and on matches.

Q. Whence do animals ultimately get the phosphorous they need.

A. It is an essential constituent of all plants, and through the plants it is taken in as food.

Q. Give the different modifications of phosphorous.

A. Several allotrophic forms, of which the red is the most important, it is obtained by exposing phosphorous in an atmosphere of carbon dioxide; it is not poisonous, nor luminous. not combustible under 28° F. over this it is converted into common phosphorous

Q. How is phosphoric acid prepared.

A. Phosphoric acid is capable of combining chemically with 1, 2, or 3 molecules of water forming 3 different acids:—

$P_2 O_5 + H_2 O = H_2 P_2 O_6 = 2 H P O_3$, Metaphosphoric acid.

$P_2 O_5 + 2 H_2 O = H_4 P_2 O_7$, Pyrophosphoric acid.

$P_2 O_5 + 2 H_2 O = H_6 P_2 O_8 = 2 H_3 P O_4$, Chlorophosphoric acid.

Phosphoric acid may be made by burning phosphorous, dissolving the phosphoric oxide in water, and boiling to convert metal into orthophosphoric acid.

Q. Give formula of tribasic sodium phosphates.

A. $Na_3 P O_4$.

Q. What two chlorides of phosphorous are known.

A. $P Cl_3$, and $P Cl_5$, used in researches in organic chemistry.

Q. What is hypophosphorous acid.

A. Prepared by adding sulphuric acid to barium hypophosphite.

Q. Name the oxides of phosphorous.

A. Phosphorous anhydride P_2O_3, and phosphoric anhydride P_2O_5; the first is produced by slow oxidation of phosphorous in air, water is absorbed and phosphorous acid is formed, the second is produced by active combustion of phosphorous; it is a white snow-like solid, with high affinity for water, and forms three different bodies by uniting with water in three proportions.

ARSENIC.

Q. Where is Arsenic obtained.

A. At times in native state, but generally as a sulphide or arsenide.

Q. What does it closely resemble in its chemical properties, and in its compounds.

A. Antimony.

Q. How is arsenic separated from its ores.

A. By washing, As_2O_3 being formed, vapors of arsenic oxide allowed to pass over red hot charcoal, $As_2O_3 + 3\,C = 3\,C\,O + 2\,As$.

Q. What are the properties of arsenic.

A. The vapor when thus prepared, condenses into a steel-gray metallic mass; odorless, tasteless, very brittle, volatilizes unchanged and without melting when heated to 1800 C. without access to air; heated in air it burns with a bluish-white light, forming arsenious oxide.

Q. What are the peculiar characteristics of arsenites and arsenates.

A. Poisonous and give off garlic-odor fumes.

Q. What are the tests for presence of arsenic.

A. Heat and dry arsenious compound, mix with charcoal and dry potassium carbonate in glass tube with small bulb on end, when the compound is decomposed and metallic arsenic deposited as a metallic ring in upper part of tube. Reinch's Test:—A thin piece of copper with a bright surface, is placed in a slightly acidulated solution of arsenic, and it will, when solution is heated, become coated with film of metallic arsenic; the latter may be sublimed from the copper by placing it in a dry narrow test tube, and heating; most of the arsenic being converted into arsenious oxide, which forms deposit of small octohedral crystals.

Q. How does ferric oxide act as an antidote in arsenical poisoning.

A. By forming with the arsenic insoluble ferric arsenite or arseniate, which is not poisonous.

Q. What is the preparation and composition of arseniuretted hydrogen.

A. Always formed when either arsenious or arsenic oxides or acids, or any of its salts, are brought in contact with nascent hydrogen; as zinc and diluted sulphuric acid which evolves hydrogen.

$As_2Cl_3 + 6\,H = As\,H_3 + 3\,H\,Cl$.

$As_2O_5 + 16\,H = 2\,As\,H_3 + 5\,H_2O$.

$As_2O_3 + 12\,H = 2\,As\,H_3 + 3\,H_2O_3$

Q. Describe modes in which metals generally occur.

A. In form of ores, from which they are obtained by roasting.

Q. What are metallic oxides.

A. Substances formed by action of oxygen on metals.

Q. What are metallic salts.

A. Substances formed by action of acids on metals.

POTASSIUM.

Q. How is potassium prepared.

A. By heating the carbonate $K_2 C O_3$ with charcoal.

Q. What are its properties.

A. Occurs in many rocks and soils; a quite soft metal, freshly cut surface presents a silver lustre, but quickly tarnishes in air; burns with a purple flame, and decomposes water.

Q. Give sources of potassium compounds.

A. Silicate of potassium by gradual disintegration of granite rocks, has entered into the soil, whence it is taken up by plants as one of the necessary constiuents of their food; which is the source of the Potassium compounds.

Q. How is Caustic Potash obtained.

A. By action of potassium on water; also by boiling dilute solution of potassium carbonate, or bicarbonate and calcium hydroxide. $K_2 C O_3 H Ca 2 H O = Ca C O_3 + 2 K O H$.

Q. How is potassium carbonate prepared.

A. By heating the bicarbonate which is decomposed $2 K H C O_3 = K_2 CO_3 + H_2 O + C O_2$.

Q. What are its properties.

A. Very deliquescent, soluble in equal weight of water, with strong basic and alkaline properties.

Q. How is potassium nitrate prepared.

A. By mixing animal refuse matter with earth and lime, and preventing lixiviation by placing in heaps; by decomposition of the animal matter, ammonia is formed, which, by oxidation, is converted into nitric acid, this combining with the calcium, forms calcium nitrate; this is dissolved by water, aud potassium carbonate, or chloride, is added when potassium nitrate is obtained. $Ca 2 N O_3 + K_2 C O_3 = 2 K N O_3 + Ca C O_3$.

Q. What are its properties.

A. Saline, astringent taste, and neutral reaction; great oxidizing agent, used in making gunpowder.

Q. What is gunpowder.

A. Mixture of 75 parts of nitre, 15 parts of charcoal, and 10 parts of sulphur.

Q. What occurs when it explodes.

A. The nitrogen, carbon dioxide and carbon monoxide occupy at moment of explosion, about 1200 times the bulk of the powder, and the explosive action is due to this sudden expansion in volume.

SODIUM.

Q. What are the sources of sodium compounds.

A. Found in small quantities in all soils; occurs in large quantities in combination with chlorine as rock salt; to a large extent in the ocean.

Q. What is the salt-cake process.

A. That by which sodium carbonate is made.

LITHIUM.

Q. What is the source of Lithium.

A. In nature in combination with silicic acid in a few rare minerals, or as a chloride in some spring waters; these compounds color flame a beautiful crimson or carmine.

Q. What are the compounds of lithium.

A. Hydroxide, carbonate, and phosphate.

SAL-AMMONIAC.

Q. How is Ammonium chloride obtained.

A. By saturating ammonical liquor of the gas works with hydrochloric acid, evaporating to dryness and purifying by sublimation; in form of white crystalline powder, or long fibrous crystals; cooling saline taste.

CALX.

Q. How is Lime obtained.

A. By burning lime-stone, calcium carbonate $Cu\ O_3\ Ca\ C\ O_3 = Ca\ O + C\ O_2$.

Q. What is Lime Water.

A. A saturated solution of calcium hydroxide in water, colorless, odorless caustic taste, and alkaline reaction.

Q. Give composition and properties of Glass

A. All varieties are mixtures of fusible, insoluble silicates, made by fusing silicic acid (white sand) with different metallic oxides or carbonates, the silicic acid combining chemically with the metals.

Q. How are colors imparted to glass.

A. By addition of certain metallic oxides, as manganese—violet, cobalt—blue, chromium—green, etc.

Q. What are the tests for presence of zinc, cadmium and manganese.

A. For Zinc: add to solution of a zinc salt ammonium sulphide, a white precipitate of zinc sulphide is produced. For Cadmium: it forms a yellow sulphide with hydrosulphuric acid, soluble in dilute acids. For Manganese: such compounds fused with borax give a violet color to the color bead; or heated on platinum foil with mixture of sodium carbonate and nitrate form a green solution in water, which an acid turns red.

IRON.

Q. How is Ferrous Sulphate obtained.

A. Green vitriol, obtained by dissolving iron in sulphuric acid.

Q. How can ferrous and ferric salts be distinguished.

A. In ferrous compounds iron is bivalent; in ferric it is trivalent.

Q. What changes occur in making wrought iron.

A. It is made from cast iron by "puddling," which burns out the carbon by oxidation; blowing air through molten iron.

Q. What are chemical characteristics of Cadmium.

A. Cadmium and compounds are of little interest, yellow sulphide is used as a pigment, and sulphate and iodide as medicine.

Q. What of Manganese.

A. Resembles iron in its physical and chemical properties, a grayish-white Metal, brittle and hard; it forms two series of salts parallel to those of iron.

Q. What of Cobalt.

A. Nearly silver white metal, salts generally of a red color; solution gives a blue color.

Q. What of Nickel, N.

A. Very similar to cobalt, nearly silver-white metal, salts give a green color.

Q. How can tin compounds be distinguished.

A. Tin is bivalent in some compounds, quadrivalent in others.

Q. Where is Titanium, Ti, found.

A. Exists as titanic anhydride, $Ti\ O_2$, also in iron ores.

Q. What of Chromium, Ch.

A. A metal of very beautiful color in its compounds; resembles aluminum and iron, also sulphur; forms two basic oxides and an acid.

Q. What of Molybdenum, Mo.

A. Occurs chiefly as a sulphide, and as lead molybdate, both rare.

Q. What of Tungsten, W.

A. Rare metal, exists as a manganese-iron tungstate, called wolfram and tungstate (scheelite).

Q. What of Uranium, U.

A. Rare metal, grayish, not oxidized by air or water, but dissolves in acids.

Q. What of Vandium, V.

A. Rare metal, found with iron and lead; has been used to make indellible ink.

Q. What of Thalium, Tl.

A. Acts as a monad and triad, resembles lead, but compounds are like potassium and somewhat like those of silver.

Q. How can compounds of tin be distinguished.

A. By adding muriatic acid to solution of stannous salt, when brown stannous sulphate is precipitated; also by adding hydrosulphuric acid to solution of a stannic salt, when yellow stannic sulphide is precipitated.

Q. Give formulæ for potassium chromates.

A. Potassii dichromas $K_2\ Cr_2\ O_7$. Potassium chromate $K_2\ Cr\ O_4$.

Q. Of oxides of arsenic and antimony.

A. Arsenious oxide—acicum arseniosum, $As_2\ O_3$.

Antimonious oxide—antimonii oxidum $Sb_2\ O_3$.

Antimonic oxide, $Sb_2\ O_5$.

Arsenic oxide, $As_2\ O_5$.

Q. What decomposition takes place in melting lead.

A. $2\ Pb\ S + 3\ O_2 = 2\ Pb\ O + 2\ S\ O_2$.

Q. How is White Lead—carbonate of lead, $2\ (Pb\ C\ O_3)\ Pb\ 2\ H\ O$, formed.

A. By action of air carbon dioxide, and vapors of acetic acid simultaneously on lead.

Q. In what do organic substances differ from inorganic.

A. Organic are formed in the living organism, and those compounds formed by their decomposition. Inorganic, those that are not living, and never have been, nor never will be.

Q. Give examples of an organized structure.

A. The different cells which make up the human body; cell of growing plants, etc.

Q. Can organic substances be formed artificially.

A. Many substances once thought to be exclusively produced in the living organism, can be formed artificially from inorganic matter, or by direct combination of the elements.

Q. Can Hydrocyanic Acid be prepared from inorganic sources.

A. Yes, and by action of ammonia on chloroform.

$C\ H\ Cl_3 + N.\ H_3 = H\ C\ N + 3\ H\ Cl$; by heating ammonia nitrate to 392° F.—$N\ H_4\ C\ H\ O_2 = H\ C\ N + H\ Cl$.

Q. What is the formula of Ethyl alcohol.

A. $C_2 H_5 HO$.

Q. Of Acetylene.

A. $C_2 H_2$.

Q. Of Acetone.

A. $(C H_3)_2 CO$.

Q. Of Aldehyde.

A. $C_2 H_4 O$.

Q. Acetanilide or Antifebrin.

A. $C_6 H_5 C_2 H_3 O. N H$.

Q. Of Methyl alcohol.

A. $C H_3 H O$.

Q. What is the source of Methyl Alcohol.

A. One of the many products obtained by destructive distillation of wood, it is a thin, colorless liquid, in smell and taste similar to ethyl alcohol.

Q. What is Ethyl Alcohol.

A. Common alcohol may be obtained from ethene by addition of elements of water, by agitation of ethene with strong sulphuric acid, when ethyl sulphuric acid is formed. $C_2 H_4 + H_2 S O_4 = C_2 H_5 H S O_4$ = ethyl sulphuric acid.

DENTAL PATHOLOGY.

Q. What is General Pathology.

A. That branch of medical science that treats of nature of diseases in general.

Q. What is Special Pathology.

A. That which treats of the nature of individual diseases.

Q. Define Disease.

A. A condition of body characterized by abnormal action of one or more of the various organs owing to an unnatural state or structural change.

Q. Into what two varieties may disease be divided.

A. Acute and Chronic.

Q. What characterize Acute Diseases.

A. Rapid onset and rapid course.

Q. What Chronic Diseases.

A. Slow in their course, and milder symptoms.

Q. What Constitutional Diseases.

A. Where the system of organs, or the whole body is involved.

Q. What Functional Diseases.

A. Where there is abnormality of function without apparent organic lesion.

Q. What Idiopathic Diseases.

A. Where one exists by itself without any connection with another disease.

Q. What Specific Diseases.

A. Such as arise from the introduction of a specific virus or poison within the body.

Q. What Septic Diseases.

A. Those arising from putrefactive fermentation of some foreign substance within the body.

Q. What Zymotic Diseases.

A. Germ diseases, or those due to introduction and multiplication of some living germ within the body.

Q. Give the predisposing causes of disease.

A. Debilitating influences, previous and present disease, excitement, hereditary influences, temperament, age, sex, occupation, etc.

Q. Name the normal pulse beats per minute from birth to old age.

A. At birth—140; 1st year—110; 2nd year—100; 5th year—90; 10th year—85; Puberty—80; Adult—75; Old age—80.

Q. What does Anæmia imply.

A. Deficiency of red corpuscles in blood.

Q. What does Hyperæmia imply.

A. An abundance of red corpuscles.

Q. What does Spanæmia imply.

A. A poor quality of blood.

Q. What does Plethora imply.

A. A fullness of blood-vessels.

Q. What changes occur in the white and red corpuscles in inflammation.

A. The white increase in number and adhere to walls of vessels and obstruct capillaries, and thus arrest progress of the red disks; some make their way through walls of vessels, and are known as exudation corpuscles; loosing vitality they become pus corpuscles.

Q. What is Gangrene.

A. Incipient mortification, or death of a part form failure in nutrition.

Q. What is Mortification.

A. Putrefactive fermentation, or death of a part from want of nutrition.

Q. What is Necrosis.

A. Mortification or death of bone, corresponding to gangrene of soft parts.

Q. What is Caries.

A. Ulceration of bone, chronic inflammation of bone.

Q. What is Exfoliation.

A. The separation of bone or other tissue from the living structure; throwing off of dead bone.

Q. What is Sequestrum.

A. A detached or dead piece of bone within a cavity, abscess, or wound.

Q. What is an Ulcer.

A. An open wound that remains stagnant instead of healing.

Q. What does ulceration imply.

A. The process of formation of an ulcer.

Q. What are the symptoms of Suppuration.

A. The symptoms of inflammation, such as heat, pain, and vascular excitement, diminish; the swelling becomes softened, there is fluctuation, and the redness changes to a yellowish or mottled color.

Q. What is meant by the "pointing" of an abscess.

A. The formation of a conical part, caused by tendency of pus to come to the surface, where softening and fluctuation occur.

Q. What effects may arise from extensive Suppuration.

A. A frequent, weak pulse, less fever, chills and sweats with flushes of heat debility, exhaustion, and even death.

Q. What does the term "adynamic" or "adynamia," imply.

A. Deficiency or loss of vital or muscular power.

Q. What is the Etiology of Dental Caries.

A. A gradual softening and disintegration of the tooth structures, appearing first as a chalky, opaque spot in the enamel, and caused by an acid or otherwise abnormal condition of the secretions of mouth—the product of fermentation of particles of food, or from systemic conditions; the progress assisted by micro-organisms.

Q. What acids are most injurious to tooth structure.

A. Nitric, sulphuric, hydrochloric and lactic.

Q. What acids are most commonly found in the mouth.

A. Hydrochloric and Lactic.

Q. What form of dental caries is caused by nitric acid.

A. White and extremely sensitive, the organic as well as the inorganic structures being destroyed.

Q. What form by Sulphuric Acid.

A. Black, less sensitive and slow in progress.

Q. What form by Hydrochloric Acid.

A. Brown, the inorganic matter being destroyed, and the organic remaining.

Q. What from Lactic Acid.

A. A light form, less sensitive than that caused by nitric acid.

Q. What surfaces of the teeth are most prone to caries.

A. Proximal surfaces.

Q. What Teeth are most prone to attacks of caries.

A. First Molars, the inferior more than superior; then Second Molars, Second Bicuspids, Third Molars, First Bicuspids, Lateral Incisors, Central Incisors, and Cuspids.

Q. What effect has illness upon susceptibility to caries.

A. When severe, the conditions influencing attacks of caries are, want of proper nutrition, acid secretions, and free fermentation on account of uncleanliness.

Q. What effect has sex on susceptibility to dental caries.

A. Teeth of females more prone than those of males.

Q. What is the *Preventive Treatment of Caries.*

A. Cleanliness from period of eruption of deciduous teeth; use of a proper tooth-brush daily after each meal, and the use of a proper dentifrice upon rising, and just before retiring, assisted by floss silk and a quill tooth-pick to cleanse proximal surfaces.

Q. What mouth washes are often useful as an adjunct.

A. Alkaline—such as lime water, borax, or bicarbonate of soda, to neutralize any acidity of oral fluid.

Q. Give formula for a *Dentifrice.*

A. R. Cretæ preparatæ, ℥ viij; Pulv. radicis iridis; ℥ iv; Pulv. ossis sepiæ, ℥ j; Pulv. sacchari albi, ℥ j; Saponis castil, ℥ j; Sodæ bicarb, ℥ ss; Pulv. cinchonæ flava, ℥ j; cochineal, ʒ j; olei rosæ, gtt. 20. Mix and reduce to an impalpable powder.

Q. What is the source of Mucous Deposit on Teeth of Children.

A. Brown or green stain—not from same sources as salivary or sanguinary calculus, but a deposit from the mucous, when the latter is in a very acid condition, in the form of fungi.

Q. How is it safely removed.

A. By finely powdered pumice on wood points or small brushes rotated by dental engine, and the surface burnished or polished.

Q. What is the effect of the Mucous Deposit.

A. It erodes enamel and facilitates attacks of caries

Q. What is the analysis of Salivary Calculus.

A. Phosphate of Lime, 62.00; Carbonate of Lime, 12.00; Animal matter and mucus, 15.00; Water and loss 11.00 = 100.00.

Q. Does Salivary Calculus injure tooth structure.

A. Indirectly by exposing necks of teeth to deleterious agents; its irritating effects are manifested on gums, causing recession, inflammation, and absorption of alveolar process.

Q. Where does salivary calculus collect in greatest quantities.

A. On lingual surfaces of lower front teeth, and buccal surfaces of upper molars; more on side least used in mastication.

Q. How does it differ in color.

A. From a light cream to a dark yellow, brown and black; soft when first deposited, but soon becomes hard and brittle.

Q. What is the nature of Sanguinary Calculus.

A. In the form of irregular crystalline granules at different points on surface of root of tooth, even to apex, or encircling root just below free margin of gum; harder and more firmly attached than salivary calculus.

Q. What is Sanguinary Calculus chiefly composed of.

A. Lime salts colored with hæmatin of blood, to which its crystalline form is due.

Q. With what form of inflammation is it in connection.

A. Suppurative process, at which stage the liquor sanguinis is transuded, degenerates during the formation of pus, and its lime salts are liberated and deposited within the area of suppuration; it is a result of ulceration; salivary calculus is a cause of ulceration.

Q. What is *Periodontitis* or *Pericementitis*.

A. Inflammation of the Peridental Membrane.

Q. What is the nature of this membrane.

A. Very vascular, very susceptible to irritation and inflammation, and highly sensitive when inflamed.

Q. What may cause its inflammation.

A. The death of the pulp, and the infiltration of septic matter through apical foramen; also mechanical violence—as a blow or the biting of hard substances.

Q. Where does Periodontitis generally commence.

A. In the Apical Space at end of root.

Q. What is the condition of Peridental membrane in apical space.

A. It is usually thicker than along root of tooth.

Q. What accounts for the intense pain of Periodontitis.

A. The membrane is confined in a bony cavity and being very profusely supplied with nerves and blood vessels, there is not space for the expansion of these when they are engorged and conjested.

Q. What are the two forms of this affection.

A. Acute and chronic.

Q. Describe symptoms of *Acute Periodontitis*.

A. First, uneasiness in tooth affected; a desire to press upon it; a feeling

of fullness; relief as long as pressure is maintained; then pain of a dull heavy character, elongation of tooth, owing to the thickening of its investing membrane; pressure no longer relieves but is painful; the gums assume a deep red color, instead of the normal pale rose hue; and become congested and swollen.

Q. How may Periodontitis be diagnosed.

A. By pressure or slight blows on affected tooth.

Q. How does Periodontitis differ from Pulpitis.

A. In that it is not generally affected by thermal changes, and pressure on tooth crown apart from pulp will cause pain in periodontitis.

Q. What distinguishes Chronic Periodontitis.

A. It is a modified form of the Acute, and may be limited to soreness of the tooth only, and slight annoyance, or it may be attended with considerable congestion and sensitiveness when tooth is pressed upon, subsiding and reappearing.

Q. Name the causes of Periodontitis.

A. Inflammation of pulp resulting in its death; salivary calculus; improper use of arsenious acid; action of mercurial remedies, mechanical violence; too close proximity of a metallic filling to pulp; loss of antagonizing teeth; overhanging portions of metallic filling in proximal cavities; constitutional causes such as malaria, syphilis, rheumatism, scrofula, etc.

Q. What is the treatment of Periodontitis.

A. Remove all irritating matter from pulp canals, apply counter-irritants to gum over root, such as tincture of aconite and iodine; local bloodletting by lancet or leeches; syringe pulp canals with warm water; disinfect pulp canals with ethereal solution of iodoform, or iodoform combined with oil of cassia or eugenol; or use eucalyptus, carbolic acid and oil of cassia, oil of sanitas, etc. Cantharidal collodion may also be used as a counter irritant; saline cathartics to relieve congestion, morphia to relieve intense pain.

Q. Why is an abscess connected with a tooth called *Alveolar Abscess.*

A. Because the collection of pus is within the alveolar cavity in the form of a sac adhering to root of tooth.

Q. Is the seat of an abscess invariably at the apex of the root of a tooth.

A. No, besides being in apical space, it is sometimes at the side of the root, or, in the case of molars, in the bifurcation of roots.

Q. Describe manner in which an Alveolar Abscess is formed.

A. The Peridental membrane being the seat of the abscess, plastic lymph is effused, which is condensed into a sac, and the accumulation of pus within the sac causes it to distend, which exerts pressure on the bone surrounding it, bringing about absorption to accomodate the increasing quantity of pus, which finally makes its way to the surface, usually by a fistulous opening through bone and soft tissues.

Q. Does Alveolar Abscess ever result in necrosis of bone.

A. Yes; when the pus burrows between the periosteum and bone and separates the two, the septic matter thus brought into contact with the bone causes necrosis.

Q. What other results may occur.

A. The pus may invade the duct of a salivary gland and cause salivary fistula; or cause inflammation of tonsils when the abscess affects an inferior third molar; or, invading the muscles of cheek and neck, cause trismus.

Q. Describe progress of Acute *Alveolar Abscess* from its inception to full development.

A. Begins in the apical space, usually by the infiltration of irritant or septic matter, through apical foramen of tooth, affecting peridental membrane, the poison existing in the form of gases or septic material generated by decomposition of pulp of tooth after its devitalization; the first symptom is acute inflammation of the investing membrane about the apical foramen, beginning with a sense of uneasiness, pressure and slight pain, succeeded by elongation of tooth from thickening of inflamed peridental membrane, pain on pressure, the inflammatory condition manifesting itself in the gum over affected tooth; violent throbbing pain, with increased redness, heat, tension, and swelling follow, lasting until the escape of the pus.

Q. What are the constitutional symptoms.

A. Fever, hot dry skin, coated tongue, prostration, constipation, and violent pain in face and neck.

Q. What symptoms characterize Chronic Alveolar Abscess.

A. May result from long continuance of acute form, or commence with less active symptoms; pain less severe, but more enervating, more diffused discoloration, more extended œdema, infiltration of pus into adjoining tissues, gradual subsidence of such symptoms upon the establishment of a fistulous opening.

Q. What effect has the pus of an abscess upon bone of alveolar cavity.

A. The bone is absorbed for the enlargement of the abscess.

Q. Name Points of escape of pus of an Abscess.

A. Through alveolar wall, apical foramen, root canal, and crown cavity, along side of root to free edge of gum, through process into antrum or nose, and facially or cervically.

Q. What teeth present unfavorable prognosis in abscess.

A. Superior laterals, inferior bicuspids and third molars.

Q. How may a fistulous opening be established.

A. By closing canals or crown cavity, and hastening suppuration; by making an opening through tissues opposite sac of abscess, and by lancing soft tissue.

Q. By what treatment may an alveolar abscess of a lower molar be prevented opening on face or neck.

A. By lancing freely to evacuate pus through gum; by supporting externally with bandage or compress to change direction of pus; by stimulating internally until an internal fistula is established; by extracting tooth.

Q. What is the result of an abscess discharging on face.

A. An unsightly scar.

Q. What is the Surgical Treatment of Alveolar Abscess.

A. Make an incision in the gum externally to apex of root and walls of abscess cavity or sac; into this opening introduce a bur attached to dental engine, cut through alveolar wall and break up sac, and also cut off end of root of tooth as smoothly as possible; if there is any necrosed bone present remove it also; then syringe cavity with peroxide of hydrogen, or this combined with bichloride of mercury; also aromatic sulphuric acid.

Q. What is the Treatment of the Different Forms of Alveolar Abscess.

A. For simple cases, consists in removal of septic matter from pulp-chamber and canals, and in acute cases to evacuate the pus through the tooth, as soon

as possible, and allow parts to rest and recover from the soreness, then, the use of some disinfectant placed in pulp canal on a pledget of cotton, tight enough to exclude saliva; the cavity may be opened from time to time for discharge of pus, if necessary; if pain returns open canal and treat as before. Where external lamina of bone has been penetrated by the pus, and a tumor is present, it should be opened and the pus discharged; if in this case the tooth is very sore, the opening of the pulp chamber may be delayed, and cotton saturated with a 95 per cent. solution of carbolic acid be introduced into the incision in gum to keep it open; after the extreme soreness has passed, the canals should be opened, all septic matter removed, and the canals thoroughly disinfected, and the opening in gum allowed to heal. Constitutional treatment is often necessary in severe cases, such as an active saline cathartic, followed by a stimulant tonic, such as ten to fifteen grains of quinine.

Q. What is Phagedenic Pericementitis.

A. A specific inflammation, infectious in character, which begins in the gingival borders and results in destruction of peridental membrane and alveolar walls; of the fungoid type.

Q. What is the treatment.

A. With a curved bistoury cut into margin of gum within limit of healthy tissue, then through alveolar process and dissect up the tumefied line, scrape margins of cavity and cauterize several times with carbolic or chromic acid; internally mild stimulants and tonics.

Q. What does the tissue of the dental pulp consist of.

A. Connective tissue group, supplied with many blood vessels and nerves.

Q. What are the processes of the odontoblasts or dentine forming cells.

A. Dentinal fibrillæ.

Q. What is in close connection with each odontoblast.

A. A nerve branch.

Q. How is the impression made on the protoplasm of the odontoblasts through injury of the fibrillæ, communicated to the sensorium.

A. By means of the fine nerve filaments found everywhere in the periphery of the pulp; and sensation follows lines of pathological changes.

Q. Why has the dentine no need of nerves.

A. Owing to the peculiar arrangement of the odontoblasts and their processes the dentinal fibrillæ; the cells being in physiological relation to the sensory nerve endings, the conditions for the translation of injury to protoplasm into the sensation of pain are complete.

Q. Do such considerations account for hyperæsthesia of dentine and injury to dental pulp by irritation of the fibrillæ.

A. Yes.

Q. What is required to make up the sum of the sensory functions of a tooth.

A. The pulp and peridental membrane.

Q. What does the sense of touch wholly reside in.

A. The Peridental Membrane, which receives the impression of even the slightest touch upon any part of surface of tooth.

Q. From what does the dentine derive its sensory function.

A. Directly from pulp through dentinal fibrillæ, and the pulp responds to injury by a sense of pain, not of touch.

Q. Does the dental pulp manifest decided sensibility to thermal changes.

A. Yes, but it does not determine degrees of temperature, or distinguish

heat from cold; and it must be aided by nerves of lips, gums, and peridental membrane to so discriminate.

Q. Where does Sensitive Dentine generally manifest itself.

A. On abraded masticating surfaces, and in carious cavities.

Q From what causes.

A. Exposure and injury or irritation of dentinal fibrillæ.

Q. What is the cause of pain when dentine is cut into.

A. The fibrillæ are injured, and these communicating with the pulp, establish the circuit of sensibility to the pulp and through it to the brain.

Q. What provision is established by nature to preserve the dental pulp from exposure on gradual loss of covering.

A. The formation of Secondary Dentine; the pulp shrinking in size the space thus left is occupied by this secondary formation.

Q. What are the safest obtunders of Sensitive Dentine.

A. Those that confine their action to the superficial layer.

Q. With what materials should very sensitive teeth be filled.

A. With a reliable non-conducting material; or if gold is used, with a preparatory layer of gutta-percha, asbestos, tin foil, etc.

Q. In the treatment of sensitive dentine what simple measures are sometimes of service.

A. Use of very sharp burs and excavators, in a direction away from pulp; application of a burnisher to sensitive surface.

Q. What agents are used as obtunders of Sensitive Dentine.

A. Tannic acid, chloride of zinc, carbolic acid, chloroform, aconite, nitrate of silver, carvacrol, oil of cloves, eugenol, campho-phenique, oil of eucalyptus, cocaine, chloral, thymol, menthol, sesquichloride of chromium, carbonate of potash, ethylate of sodium, crystallized carbolic acid and caustic potash equal parts, dehydration by warm air, rhigolene spray, and dento-electric cautery.

Q. What is the *Dental Pulp*.

A. The soft tissue that occupies the central cavity of each tooth.

Q. How is it divided.

A. Into coronal portion or bulb, and canal or root portion.

Q. What does the form of Dental Pulp correspond to.

A. The general form of the tooth in which it is located.

Q. What is the appearance of Dental Pulp when in a healthy condition.

A. Of a grayish-white color.

Q. What is its appearance when in a state of active inflammation.

A. Of a bright red color, the capillaries being visible.

Q. What is the mass of pulp-tissue composed of.

A. A semi-gelatinous matrix, thickly studded with cells a little apart from each other

Q. What other tissues form parts of the dental pulp.

A. Blood vessels and nerves.

Q. What are the functions of the dental pulp.

A. The formation of the dentine, and maintainance of vitality of the teeth.

Q. Describe the arrangement of Blood vessels of Pulp.

A. Very numerous before roots are formed, afterwards when apical foramen is completed, less numerous until they consist of two or three branches only, which divide into many capillaries and thus form a complete network of vessels within substance of pulp.

Q. What is the difference in size of the arteries and veins of Pulp.

A. The veins are slightly larger than the arteries, and freely anastomose with each other.

Q. In what manner do the nerves enter the pulp.

A. Through apical foramen by a single bundle, and divide in the canal, and subdivide in the coronal portion, sending off filaments to the periphery.

Q. Does the pulp show any decided sensibility to thermal changes.

A. Yes; there appears to be a certain association in this respect between it and the peridental membrane.

Q. What do these manifestations show.

A. That it is necessary to protect an irritant pulp from thermal changes.

Q. What is a test for diseased condition of pulp.

A. When any pain in region of face or ear is decidedly increased by filling mouth with cold or warm water.

Q. By what means can periodontitis and pulpitis be diagnosed.

A. If periodontitis is present, the tooth is sensitive to touch, and not sensitive to moderate thermal changes; in pulpitis the tooth is sensitive to touch, but very sensitive to changes of temperament; in reflected pain from pulpitis the tooth is not sore to touch, while radiating pains are absent in periodontitis without pressure of a tooth that is sensitive to touch.

Q. Do we have swelling of soft parts about tooth in pulpitis.

A. No; such swelling is indicative of periodontitis, and alveolar abscess.

Q. What does Hyperæmia of Dental Pulp imply.

A. That its bloodvessels are congested or too full of blood.

Q. What renders pulp of a tooth susceptible to morbid impressions.

A. Peculiarities of temperament, habit of body, condition of health, condition of the tooth structures.

Q. What does Hyperæsthesia imply.

A. An excessive state of irritability.

Q. Does such a condition depend upon any organic change in the tissues of a tooth.

A. It may exist independent of any organic change, either in the pulp, dentine, or enamel.

Q. What is the most common cause of hyperæsthesia of pulp.

A. Caries, even before it has penetrated to the pulp.

Q. What constitutional causes.

A. Impaired digestion, and disordered bodily functions.

Q. What local causes of irritability of pulp.

A. Impressions of heat and cold, acids, etc.

Q. What is the Treatment of Irritability of Pulp.

A. Remove cause; if from acids—the use of alkaline washes such as bicarbonate of soda, lime water, etc., if from impressions of cold or heat through a metallic filling, such fillings should be removed and either replaced by non-conducting filling material, or the metallic filling renewed with a preparatory layer of gutta percha or other non-conductor, covering the sensitive surface.

Q. When must such treatment be instituted.

A. Before inflammation of pulp has commenced.

Q. What is the treatment in cases of excessive sensibility of dentine owing to abrasion and which would result in irritation of pulp.

A. The application of nitrate of silver; also capping.

Q. Why is an inflamed pulp (pulpitis) so excessively painful.

A. Because pulp is enclosed in a cavity with unyielding walls, where its expansion is impossible, and as its vessels become distended with blood, there is undue pressure upon its nerve filaments.

Q. Is Pulpitis confined to carious teeth only.

A. No; teeth free from caries may be affected as well as decayed ones.

Q. What determines the severity of the pain.

A. The structure and condition of the affected tooth, and state of health.

Q. Besides irritation of fibrillæ, what other causes of Pulpitis.

A. Contact of irritating matters (carious for example), mechanical violence, sudden thermal changes (heat and cold conveyed through tooth structure, or through a metallic filling), pressure of a filling on thin lamina of dentine, use of improper filling materials, improper use of the teeth, etc.

Q. What constitutional symptoms may attend Pulpitis.

A. Headache, earache, constipation, full, quick pulse, dry skin, furred tongue; due perhaps to impaired health.

Q. Is an inflamed pulp amenable to treatment.

A. Yes, in the earlier stage of inflammation, when other conditions of system are favorable, as an inflamed pulp will recover if placed in good hygienic condition.

Q. What is the Treatment of Pulpitis caused by an exposed pulp.

A. Cleanse cavity of all extraneous and irritating matter, syringe with tepid water made alkaline by a little bicarbonate of soda, dry cavity, and make application of tincture of aconite; or cocaine, carbolic acid, glycerine and water; or carbolic acid and chloroform; or a paste of oxide of zinc and carbolic acid; or 10 per cent. solution of carbolic acid, oil of cloves, oil of cajeput, iodoform, iodol, iodoform and carbolic acid, carefully applied, and lightly confined in cavity; if the cause is from pressure of a filling, this should be removed and the pulp treated as described; for constitutional symptoms when present, saline cathartics, blood letting, leeches, etc. If inflammation has not advanced too far, the final treatment is capping pulps with oxychloride of zinc over oxide of zinc and carbolic acid.

Q. What are the premonitory symptoms of the inflammation extending from pulp to peridental membrane.

A. Uneasiness about root of tooth, a disposition to press on tooth which gives relief, a gnawing sensation, and gradually increasing discomfort or pain.

Q. When the inflammation of pulp results in suppuration how long does it take to run its course.

A. The time varies, generally from three to ten days.

Q. When pus has formed what measure may give relief.

A. Drilling a vent-opening through crown, or neck, or through the root, for escape of pus.

Q. May Pulpitis result in suppuration without the formation of an alveolar abscess.

A. Yes, abscesses may form in the substance of the pulp, beginning at its surface near point of exposure, progress until the entire pulp becomes a mass of pus full of micro-organisms.

Q. Does a dead pulp allowed to remain in a tooth invariably cause trouble.

A. As a general rule it does sooner or later, although such a tooth may re-

main quiet for weeks, months, or even years, and the effects, in the form of suppuration and pain, be manifested as a result of thermal changes, exposure to draughts, or wet feet, etc.

Q. Should a pulp be devitalized only to relieve pain.

A. No, devitalization should only be resorted to after all other means to relieve the irritation or congestion have failed.

Q. Why is the normal living pulp so necessary to the tooth.

A. Because it is the nutrient organ of the tooth, and with the peridental membrane makes up the sensory functions of the tooth.

Q. In a case of extreme agony from an irritable pulp what is the treatment.

A. First palliative remedies; remove all extraneous matters from cavity; syringe with tepid water made slightly alkaline with carbonate of soda; then apply aconite and chloroform combined; if a careful examination shows the pain not to be due to actual exposure of pulp, apply either carbolic acid combined with iodoform, or acetate of morphia with oil of cloves, and afterwards a capping of lacto-phosphate of lime in form of paste, or iodoform, carbolic acid and oxide of zinc in same form, and over the capping a temporary filling of gutta percha, or oxychloride of zinc.

Q. If the loss of the pulp is inevitable, how may it be devitalized.

A. Either by the application of a devitalizing agent, such as arsenious acid; by immediate extirpation; or by the application of the actual cautery.

Q. When arsenious acid is used how long is it necessary to keep it in contact with pulp.

A. From twelve to twenty-four or forty-eight hours, according to strength of devitalizing combination, the presence of pain on its application, and the nature of the tooth structures.

Q. How does arsenious acid act on the Pulp.

A. By first exciting the sensory nerves, then paralyzing them, exciting a degree of inflammation in proportion to the quantity of arsenic employed; the excitement passing away, the arsenic is gradually absorbed.

Q. Does death of the pulp immediately follow.

A. No, if an excessive quantity is applied, the inflammation suddenly excited will resist the absorption of the arsenic; hence in many cases it is better to reduce the inflammation before applying the arsenic.

Q. When properly applied after the inflammation has been reduced, what quantity of arsenious acid will devitalize the pulp.

A. About one-hundredth part of a grain.

Q. What is the quantity of arsenic usually employed for devitalizing pulps.

A. From one twenty-fifth to one fiftieth of a grain, depending on position and character of exposure, and allowed to remain twenty-four hours.

Q. After devitalization what should then be done with the pulp.

A. Entirely removed with a steel, temper-drawn, barbed broach; or better, by means of an instrument made of steel wire filed down to proper size, flattened at extremity, and bent in the form of a delicate hook, and tempered at hook portion only.

Q. How is such an instrument manipulated.

A. By passing it carefully up canal as far as possible, then rotating it to cut off connection of pulp.

Q. What is the proper method of applying and confining the arsenical preparation in the tooth.

A. Dry out cavity, after removing debris of decay and foreign matter, as these may prevent action of arsenic on pulp tissue, make direct application of agent to pulp surface, cover this with a lead cap, and fill balance of cavity with gutta percha.

Q. What is the result from carelessness in permitting arsenic to come in contact with soft tissues, such as the gum.

A. Extensive sloughings.

Q. Is the arsenic readily absorbed by organic matter.

A. Yes, hence the greatest care must be observed in its use.

Q. How long a time should elapse after the arsenic has acted, before the attempt is made to remove the dead pulp.

A. Some prefer waiting for several days or even a week or more, until partial sloughing of pulp occurs, when it may be removed painlessly.

Q. How may the pulp be devitalized and removed with a minimum amount of pain.

A. By the use of local anæsthetics, and the galvano-cautery.

Q. Why is it necessary to remove the dental pulp from the teeth.

A. To prevent the putrefaction which would ensue from its presence and subsequent periodontitis and alveolar abscess.

Q. When is the proper time for filling the roots after the removal of the pulp.

A. The safest method is to apply an antiseptic dressing to root canals, such as oil of eucalyptus, eugenol, or eugenol and iodoform, or oil of cloves, and let case rest for a short time, so as to overcome any putrefaction which may occur from a collection of fluid and lymph in canal.

Q. What is the method of destroying pulps of single root teeth by means of a blow on a piece of wood introduced into root canal.

A. A piece of hickory or orange wood is filed down and smoothed by emory paper to a fine attenuated point of such a size as will enter pulp canal. The end of this is moistened in carbolic acid, and being introduced as far into the canal as can be done without causing pain, a sudden well directed blow with a hand mallet drives the point of the wood into the pulp, an operation which is either painless according to the experience of some patients, or causes pain of very short duration.

OPERATIVE DENTISTRY.

Q. Into what two processes may the Filling of Teeth be divided.

A. Into Surgical and Mechanical.

Q. What does the Surgical comprise.

A. Separation of teeth, relief of sensibility, removal of carious portion, the formation of the cavity to retain the filling.

Q. What does the Mechanical comprise.

A. Preparation of filling material, insertion and finishing of filling.

Q. What is the period of life when caries is most active.

A. From eighth to thirtieth year.

Q. Is the occurrence of caries in deciduous teeth an indication that it will also occur in permanent teeth.

A. Yes; hence constant care and frequent inspection are necessary

Q. What may be determined by special examinations of the teeth.

A. Number, position, and extent of carious cavities.

Q. Where should the examination of the teeth be commenced.

A. At the median line, and each tooth on the right and left sides carefully inspected.

Q. What is the preliminary step to the treatment of caries in the proximate surfaces of teeth.

A. The securement of space by temporary separations.

Q. How are teeth thus separated.

A. By the swelling of cotton or tape, the resilience of strips of india rubber, and immediate wedging.

Q. Where is immediate wedging most applicable.

A. To the front teeth when but little space is required for examination, and the treatment of small cavities.

Q. How is immediate separation made.

A. By wedges of wood, and metallic separators acting on the wedge principle.

Q. How is superficial caries treated.

A. By removing the soft carious part, and cutting away so much of the adjacent solid structure with chisels, as to make a plane surface ; then polishing the cut surface by corundum flour, pumice, and oxide of tin.

Q. How should the cutting be done on proximal surfaces.

A. In such a manner that while the teeth touch at a small point near cutting edge, they are apart near gum, and the inner portion of space is made larger than the outer portion; the form of surface should appear slightly rounded; this gives a self-cleansing space.

Q. Is such cutting away of the front teeth of children which have a tendency to overlap, objectionable.

A. Yes, it would only enhance the irregularity.

Q. Why is such cutting away of proximate surfaces of bicuspids and molars except in space between inferior bicuspids, objectionable.

A. Because so much would have to be cut away as to disfigure the teeth, and the artificial space thus made to prevent proximal closure, would permit the food to be forced against the gum and result in discomfort and injury.

Q. In what part of the tooth is the manifestation of dentinal sensibility greatest, when excavating.

A. Near line of junction of enamel and dentine, and on the direct radiant line from the coruna of pulp to the periphery of the dentine.

Q. In what direction should the movements of the cutting instruments be made.

A. Away from the pulp.

Q. How is the application of heated air made for relief of sensitive dentine.

A. Dry cavity thoroughly, and use a hot air syringe, the first blasts made at intervals of a few seconds ; as pain diminishes by the moisture of cavity being removed, the force of the blasts of hot air is increased, and the intermissions shorter and less frequent, until the pain ceases, when the operation can be gone through with.

Q. What is Dr Bogue's method of using veratria combined with carbolic acid.

A. Protect tooth by rubber dam, apply the following combination, wait a

time, cleanse with alcohol and air—dry the cavity : veratria, gr. vj ; pure carbolic acid, gr. vj ; absolute alcohol minims, vj; glycerine, gtt. v.

Q. For what cases is nitrate of silver serviceable.

A. The sensibility of dentine after removal of superficial caries, and that occurring about necks of teeth ; but only for posterior teeth.

Q. What may be resorted to in cases of extreme sensibility of dentine when other remedies fail.

A. Anæsthesia as far as second stage of cerebral excitement, by means of sulphuric ether.

Q. What temporary filling materials may afford relief in sensitive dentine by slight thermal irritation, which excites calcification of the fibrillæ.

A. Gutta percha, oxyphosphate and oxychloride of zinc.

Q. Of these which is the most effective.

A. Oxychloride of zinc, although it may be more irritating at first.

Q. Why is it dangerous to use arsenious acid for sensibility of dentine.

A. Because of its tendency to devitalize the pulp, as it is readily absorbed.

Q. In preparing a cavity for filling, to what extent should it be opened.

A. So as to render all parts accessible, or easy access to every portion.

Q. What is the general rule in opening cavities.

A. To remove all of carious portion from about orifice, and also all overhanging portions of enamel liable to be broken down in the process of filling, or afterwards by the force of mastication, or, although strong, will not admit of gold being properly inserted, etc.

Q. What are the general rules in regard to the formation of cavities for retaining the filling.

A. The sides for a certain distance within orifice should be nearly transverse to the plane of the general face of the proposed filling, and should have an inward divergent direction ; such sides may be grooved or undercut to secure retention of filling, such undercuts or grooves extending to all parts of the boundary, which may be done except in cases where, owing to loss of structure, a contour filling is required, when retaining pits may be resorted to, or gold screws; the borders or margins of cavity should be counter-sunk to protect them from injury during introduction of filling, and to facilitate the perfect adaptation of the gold to such margins, and to permit the gold to be carried to the outer limits of the surfaces of certain teeth as a protection against force of mastication as in the case of proximal fillings; the countersinking will also enable the margins of a cavity to be well defined in the finishing and polishing process, and the degree of countersinking will vary from the removal of the acute edge to a depth corresponding to the thickness of the enamel ; deeper for cohesive than for non-cohesive gold.

Q. What is meant by a Simple Cavity.

A. One permitting easy and direct approach to all parts of it, and bounded by strong walls, such as are confined to grinding, buccal, labial and palatine surfaces.

Q. What may be termed an Ordinary Cavity.

A. One with an indirect approach, where the instruments cannot be applied at any desired angle, such as proximal surface cavities.

Q. What is meant by a Compound Cavity.

A. Cavities left by the union of two which began on different surfaces, coalesence occuring by the extension of the decay from each.

Q. What is the method of opening and forming simple cavities.

A. First cut down enamel at central part until orifice is nearly as large as interior; if sulci are present, these should be opened out to their extremities, although they need not be made so deep as the larger part of cavity; no more need be cut away from larger part or from sulci than will leave perpendicular walls, and a concave bottom; or a slight groove or undercut may be made around the larger part of the cavity, within the margin of the enamel.

Q. How may Labial surface Cavities be prepared.

A. Procure a regular outline by small chisels or wheel-bur in the healthy enamel; a retaining point in each lateral wall if cavity is shallow; if broad, a slight groove around but within the margin; the floor be made flat vertically but correspond to general outline of tooth horizontally; slight countersunk margins to well define outline.

Q. How may Buccal surface Cavities be prepared.

A. The walls or sides should be made transverse to a flat floor; and on account of more difficult approach by interference of cheek, the sides should be undercut to make the introduction of the filling easier, and facilitate the retention of the first pieces of gold.

Q. How may Palatal and Lingual Surface Cavities be prepared.

A. Opened by directing drill nearly parallel to axis of tooth, and finish removal of caries with small round-ended excavators; when on lingual surfaces of inferior molars operation is more difficult owing to inward inclination of these teeth, interference of tongue, and the pulp being close to this surface; a wheel drill is best for removing caries and forming cavity; amalgam is preferred by many for such cavities.

Q. How prepare Proximate surface Cavities.

A. *For Small Proximate Cavities of Front Teeth:* Separate sufficiently, define margins with thin enamel chisels; and it is admissable to remove a small part of palatal surface to facilitate approach; then with small rose-drills or excavators, remove caries and form cavity from palatine surface; square cervical wall, slightly groove palatal wall with small-wheel burr, or a bent hoe-shaped excavator, slightly countersink and smooth surface of enamel.

For Large Proximate Cavities in Front teeth; Labial Wall Perfect: Make required separation; operate from palatine surface; cut down at middle part of palatal enamel wall nearly to bottom of cavity to secure easy access; cut away thin palatal wall with a chisel, until a greater thickness is reached, and remove caries with a thin spoon-shaped excavator; as cavity extends from neck to near cutting edge and is usually nearer palatal than labial surface, the latter having a concave border on inner surface, it need not be undercut or grooved; allow normal dentine to remain at base of labial margin, leaving a concave instead of flat bottom; make a retaining pit in the base of palatal wall near cervical wall which is generally thick enough, and a small groove from this pit to channel of approach; cut the cervicle wall up to cementum, so that no thin line of enamel is left at that point; make cervical wall transverse to axis of tooth, and a retaining pit may be made in the wall.

For Large Proximate Cavities in Front Teeth; Labial Wall Imperfect: No support can be had from remaining part of labial wall, hence all must be made in tuberosity or thick part of base of this wall near the cervical, upon the inner plate of enamel, and by a retaining pit in cervical wall; separate sufficiently; open cavity by cutting away labial wall until a smooth strong

border is obtained, with a regular curve; allow greater part of palatal wall, if perfect, to remain, or remove as little as is necessary for safety, and to bring gold a little over edge of this wall if lower teeth are abrading it; cut down cervical wall squarely and extend cavity at cervical wall to cementum, if otherwise, a thin line of enamel only would remain; make retaining pit and groove in outer part of cervical wall, and a slight undercut along base of labial and palatal wall.

For Proximate Cavities in Front Teeth extending to Cutting Edge: The Labial wall being usually frail, and pulp alive, all support is to be obtained by cutting into stronger and thicker parts at base of cavity; such cavities require contour fillings, and it is often necessary to remove angle of crown at cutting edge and restore it with gold; where caries of this nature occurs on teeth worn to thick cutting edges, a dovetail form of cavity on cutting edge, may afford retention.

Q. How Prepare Cavities on Mesial Surfaces of Bicuspids and Molars.

A. For small simple cavities wide separations are necessary if the grinding surface is not cut into in order to approach such cavities; if so, then a slight separation is required; but location of small cavities on such surfaces will determine this point; if cavity can be approached without cutting away grinding surface, the case is simple; if near grinding surface, the overhanging enamel should be cut away and a compound cavity made; the greatest objection to forming small simple cavities of this kind on such surfaces, is the probability of the teeth coming together, and failure from caries, When cavity is confined to mesial surface, the formation is done with rose-drills and the cavity extended towards gum; some prefer to extend slightly below gum if tooth is of poor structure; some also prefer to open cavity by cutting away buccal margin and permit gold to appear slightly in front; a groove is made in both outer and inner walls; a shallow retaining pit in cervical walls, and a pit towards or under each cusp. Larger cavities in this surface necessitate the removal of more of the grinding surface leaving a dove-tailed or triangular space, which serves to anchor the filling; the filling having to be built on cervical wall, if lateral walls are frail, hence its surface should be made transverse to axis of tooth, and its outline should meet that of outer and inner walls by an easy curve, not by an angular one; fissure drills and chisels may be used for forming margins of walls, so as to form a double dovetail, one on mesial and the other on grinding surface.

Q. Why is it dangerous to make retaining points or pits at apex of proximal surface cavities.

A. Because such weaken the plates of enamel that come together at that point.

Q. How prepare Distal Surface Cavities of Bicuspids and Molars.

A. The grinding surface wall is generally removed to afford easy approach; cut away grinding surface wall at central part to bottom of cavity, if lateral walls are strong; cut grooves in lateral walls and extend them, if admissible, into sulci of grinding surface.

Q. How may Grinding Surface Cavities of Bicuspids and Molars be prepared.

A. Determine extent of sulci caries; open with fissure drills and gouge-shaped chisels; in cutting out sulci, extend opening until it includes entire fissure; make extremities round, not angular, for better adaptation of gold;

when fissures are large, use small curved chisels, or fissure drills; begin at central part, and make parallel walls or sides to the grooves; in bicuspids the caries usually commence in two pits in sulci joined by a slight line, which should be cut through so as to unite the pits which are to be opened out; in case one of the sulci of grinding surface of an upper molar is connected with sulci of palatine surface, they should be connected in opening them out; and the same should be done in case of lower molars where sulci of grinding surfaces joins sulci on buccal surfaces.

Q. How prepare deep Grinding Surface Cavities.

A. Cut down with chisels the overhanging enamel at central part, until orifice is as large, or nearly so, as interior, and open out any sulci which may extend from central part; but depth of opened out sulci need not be as great as central cavity, and their width need not be greatly increased; the floor of cavity can be left irregular, and not be flat; better to make it concave; the perpendicular part of cavity need not be deeper than thickness of enamel, if caries has not penetrated further; the margins should be counter-sunk by bud-shaped burrs or corundum points.

PROSTHETIC DENTISTRY.

Q. What preliminary measures are necessary for obtaining Impressions of Mouth.

A. Note condition of oral secretions and mucous membrane; if oral secretions are thick and viscid, rinse with warm water, or solutions of salt and alum; if mucous membrane is very soft and spongy, use for some time dilute phenol sodique or other astringent mouth-wash.

Q. What is the method of obtaining a Full Upper Impression in Plastic Materials such as Wax, Gutta Percha, or Modeling Composition.

A. Operator stands to right and a little back of patient, who occupies a common chair; direct patient to open mouth but not too wide as this lessens size of orifice laterally; press away right side of mouth with corner of cup, and distend left side of mouth with one or two fingers of left hand, pass cup and contents into the mouth, adjust it to ridge, then press up evenly and firmly until all parts are imbedded in material; direct patient to draw down upper lip, and with finger over it, the operator presses all around the rim, at the same time keeping the cup in position by a firm pressure over its concave surface with middle finger of left hand, while the thumb and forefinger retain hold of handle of cup.

Q. How may such an Impression be safely removed from mouth.

A. In case of plastic materials it is best done by directing patient to give a cough, or expel air forcibly from lungs, or attempt to swallow, and thus overcome the atmospheric pressure.

Q. How can such substances be hardened before removal from mouth.

A. By ice water on a small napkin, or a piece of ice in napkin.

Q. What general form of cup is necessary in Full Lower Impressions.

A. One which conforms to height and thickness of ridge, with sides of sufficient depth and width.

Q. What is the method of obtaining a Full Lower Impression in same materials.

A. The patient is seated in an operating chair, the head against head-rest, and operator to the right and more to the front; the cup introduced in same manner as for full upper impression and no downward pressure made until it is well adjusted to ridge, the cheeks pressed away to prevent including folds of membrane between cup and ridge; the patient directed to raise and protrude tongue so as to free inner side of ridge of fold of membrane to its full depth, the tongue is then drawn back into mouth, after cup is in position over ridge, and downward pressure is made on cup over region of bicuspids on each side with two fingers of each hand, while the thumbs are on each side under jaw. In removing impression, one angle of cup should pass out of orifice of mouth first after the entire impression is raised clear of ridge.

Q. What is the method of obtaining Full Upper and Lower Impressions in Wax and Plaster combined.

A. First obtain the impression in wax; then remove about one line of thickness of wax surface after hardening it; mix a thin batter of plaster, and cover with it the surface of wax impression. Return whole to mouth, adjust it to ridge and make pressure upwards, hold firmly in position until it hardens; remove and prepare surface for pouring model.

Q. What precautions are necessary in the use of Modeling Composition.

A. Place tissue or other paper in the bottom of a shallow pan to prevent material from adhering, use boiling water to soften it, dry on a cloth after removal from water; pass impression cup over a flame, or immerse it in the hot water, then dry its surface to prevent the material from leaving cup on withdrawing it from mouth; build it into cup to approximate form of arch, leaving a surface free of folds; then proceed as with wax, pressing it well around outside of ridge, and with index finger upward and forward to part overhanging back of cup. Allow it to cool for about a minute retaining it firmly in position, and then carefully remove it from mouth, so that its sides are not compressed by corners of mouth; plunge it into cold water until hard; and remove from water only when ready to pour model.

Q. How may a Partial Impression be obtained with wax and plaster combined.

A. By first taking an impression with wax, and when hard, removing a line in depth of entire surface, and enlarging impressions of the natural teeth; then score the entire wax surface with point of knife to enable plaster to adhere to it; then pour thin batter of plaster over wax surface, filling also impressions of teeth and return to mouth; if on removal any portion of plaster should break away from wax surface, it can be accurately restored.

Q. How may a Full Upper Impression in Plaster be obtained.

A. Select cup a little larger than mouth; if palatine portion of mouth is high, wax may be built up on cup to raise it in centre. To prevent plaster batter from running from back of cup a slight rim of wax may be built across; fill cup with plaster batter just thick enough to run in a stream; insert cup as for wax impression and press up gently with rear slightly in advance of the front; retain in mouth until the surplus plaster in bowl breaks with a sharp fracture; then remove impression by first wetting finger and with it raise lips and cheeks, and carefully make pressure on handle of cup; if this does not loosen it, direct patient to give a slight cough, or attempt to swallow, which will admit air and break up the atmospheric pressure; where there is a deep undercut, draw impression forward and downward at same time.

Q. How obtain a Full Lower Impression in Plaster.

A. At times it may be necessary to deepen rim of cup with wax, at other times to cut it away; mix plaster batter just thick enough to be retained in cup when it is inverted, and place enough in cup so that it may extend well down on inside of ridge at the back ; before introducing cup press out cheeks with finger or handle of mouth glass, so that membrane does not fold over ridge; or have patient raise tongue above cup as soon as cup is placed in mouth, and before pressing it down over ridge; after pressing cup down, have patient lower tongue to force plaster close to ridge; slightly press cheeks against plaster, and allow it to harden, after which raise lips and cheeks away from cup, and raise up with handle, and remove from mouth.

Q. How may Partial Impressions in Plaster be obtained.

A. By making impromptu cups of sheet gutta percha, shaped over a model made from wax impressions of mouth, and cup so flexible as to allow it to be bent outwards at points opposite undercuts or dove-tailed spaces between teeth, and thus fracture the thin plaster covering surface of such a cup, the parts being afterwards restored to proper positions.

The surface of gutta percha cup is roughened with point of a warm blade of knife, to assure adhesion of plaster to it; or another method may be resorted to for upper partial impressions; place enough plaster against palatal surface to fill mouth even with grinding surfaces of teeth; if it is desired to obtain impression of buccal and labial surfaces place a little plaster inside of rim of cup then iusert cup in mouth so that it passes beyond the plaster, using same precautions as for a full impression.

Q. For securing a Partial Lower Impression in Plaster when teeth are irregular, or stand in different directions, what is the method.

A. First obtain an impression in wax, and from it a plaster model; then fit wax caps over entire crowns of plaster teeth, but not the necks; remove wax caps from model and place them on natural teeth; then take the impression in the usual manner and remove it same as a full impression ; replace plaster that may break around necks of teeth in impression.

Q. When should Partial Plaster Impressions be removed from mouth.

A. Where there are no undercuts or dovetails as soon as it hardens enough to break with a sharp fracture; otherwise allow plaster to become very hard, so that cup may be detached and the plaster cut into and removed in sections which are afterwards replaced.

Q. How may the Articulation be obtained.

A. For metal work the metallic plate is used; for vulcanite or celluloid a base plate of wax, gutta percha, paraffine and wax, or modeling composition, is necessary, such base plate being softened and shaped over plaster model; a rim of wax is built upon the plate over alveolar ridge, of the form of the arch; tried in mouth and trimmed or added to as required, and so placed as to restore contour; to prevent too close a bite a small block of soft wood is inserted in the wax rim at a point opposite occluding front teeth, the grain of the wood running parallel with ridge so that small portions may be easily split off until the proper length of teeth is obtained, which is determined by lower natural teeth coming in contact with block of wood, and thus preventing patient from biting too far into wax rim.

Q. When in mouth, and lips at rest in natural position, what should be the size of the wax rim.

A. About one sixteenth of an inch for upper bite, and one sixteenth shorter than lip for lower bite.

Q. Should patients ever be requested to "bite" naturally.

A. No, as they are certain to do just the opposite.

Q. How is Articulating Model made.

A. For full upper or lower case the wax articulation is placed upon model in case of plastic work (or plaster is run into palatal surface of plate in metal work), and fastened by passing a heated spatula around edges. If a metal articulator is used, the model with articulation is secured to this with plaster; the cavities made in wax by teeth are then filled with thin plaster batter, and by jarring, each plaster tooth is made perfect; enough of plaster somewhat stiffer is built upon this to bring it even with top or bottom of articulator, this is smoothed and allowed to harden, when it is separated, and wax removed; the base plate is then fastened to the model, and teeth arranged on it; if the case is of metal, pouring the plaster into concave surface of metal plate, and building it up to top or bottom of articulator, forms the half part, and the teeth are arranged on the metal plate. Another method is to obtain a wax impression of opposite jaw and a plaster model from this; the plaster teeth of this model are inserted into depressions made in wax articulation by the natural teeth, and fastened by means of melted wax; all parts are then attached to metal articulator as before described.

Q. Describe how outline of a full upper denture may be marked on plaster model.

A. Begin at heel of model, do not encroach on soft palate, hence, curve the plate-line to avoid doing so; extend line so as to cover condyles or maxillary tuberosities; extend it as high as possible on outside of ridge without interfering with muscles and reflected portions of membrane of cheeks and lips, and as outline is drawn forward allow room for frœna on either side and front of mouth; carry outline as high on outside of ridge as plate can be borne with comfort, the highest points over canines, and a lower line back of such points.

Q. What should the Vacuum Cavity conform to in shape.

A. Somewhat to general contour of palatal arch; if this is broad, make cavity broad; if long and narrow, make cavity long and narrow.

Q. What is the general rule in regard to size of Vacuum Cavity.

A. About one quarter the area of space enclosed by a line drawn around centre of ridge and back edge of plate.

Q. How mark outline of vacuum cavity.

A. Do not extend it over rugæ, if possible, and let it be at least one-eighth of inch inside of back edge of plate.

Q. How mark outline for a Full Lower Denture.

A. Carry line on model as far over ridge on outside as the integument will allow, and give room for frœna; on inside let outline be drawn so that plate will rest in depression extending along inner surface of ridge; the back of plate should just cover curve of gum so that edge will not interfere with tongue; the plate must not be too wide, nor extend too far back; if integuments greatly overlap ridge, mark outline so that plate is quite narrow.

Q. How mark outline for Partial Upper Dentures.

A. So that it may fit accurately around remaining natural teeth, but not rest on them.

Q. How outline Partial Lower Dentures containing Bicuspids and Molars.

A. Let plate extend in front up over lingual surfaces of six anterior natural teeth, (not cut out to extend around such teeth,) that plate may not press painfully on gums, and also for the reason that a thinner plate can be made to extend back of anterior natural teeth, which although thin is stiff and unyielding owing to its peculiar shape, all of which is secured by allowing plate to extend just above rounded portion of natural teeth and rest on the broad, flat surfaces approaching their cutting edges.

Q. How far down should outline of such a plate extend on front part, inside.

A. So far down behind six front teeth that tip of tongue will not be liable to get under it.

Q. When lower teeth anterior to 2nd or 3d molars are to be inserted, how form Plate.

A. A tip or tongue of metal may be attached to back part of plate over ridge, so as to extend up the mesial surface of natural molar on each side of mouth, and slightly over crown on grinding surface; such tongue of metal will assist in holding denture in position by hooking over molar, and transfer pressure of mastication from gum to molar on each side.

Q. How determine when jaws close properly in securing the "Bite" or antagonism.

A. By arresting the movement of mouth in act of speaking; or by having patient place tip of tongue against roof of mouth on opening mouth, and retaining it in that position on closing mouth, or biting into wax rim; or by depressing chin on breast, and then causing the mouth to be closed.

Q. How may proper length of "Bite" be determined.

A. By the general expression—the lips should rest easily together, without effort, stretching or pouting.

Q. At what points is considerable fullness of gum usually required to give expression and reduce wrinkles from angle of nose to corners of mouth.

A. Over canine teeth.

Q. Where should fullness of gum be avoided.

A. Under nose.

Q. What determines selection of Plain or Gum teeth for a Denture.

A. Degree of absorption of process; presence of roots of teeth; unusual projection necessary; or irregular arrangement required.

Q. In selecting Artificial Teeth what points have to be considered.

A. Size, shape, color, character, peculiarities, and, for partial cases, teeth to match remaining natural ones.

Q. As regards Size.

A. The width and length generally, and especially the relative width and length of central and lateral incisors and canines.

Q. As regards Shape

A. Whether teeth are to be perfectly straight or wedge-shaped, larger in diameter across cutting edges than across necks.

Q. As regards Character.

A. Whether teeth are to be flat or curved (convex) on labial surfaces, curved transversely or from gum to cutting edge; whether thin, translucent, and of delicate form, or thick, dense, and massive.

Q. As to Peculiarities.

A. The presence or absence of grooves, ridges or lines transversely or longi-

tudinally over crowns; shape of cutting edges according to age, or some peculiar form, straight or rounded; whether uniformity in shape is desirable or more of curvature on posterior than anterior edge.

Q. As regards Shade.

A. Should match natural teeth if any remain, except when latter are greatly discolored, then the color of artificial should be the least noticeable; rather a little too dark than too light.

Q. As regards any difference in Size.

A. No difference if possible; if any is necessary, larger teeth can be ground down so as not to mar them—grind from sides or cutting edges, not from labial surfaces; better select teeth a little too large than too small.

Q. As regards position of Pins.

A. Cross pins will often interfere with natural teeth of opposite jaw, and such pins weaken teeth more than longitudinal pins. Cross pins afford more leverage, become stretched, and are liable to be broken off, and not suitable for close bites; but if the other pins will not answer, the backings should extend to cutting edge. For bridge-work, cross pins render teeth more liable to fracture in soldering.

Q. How is width of artificial incisor teeth to be determined.

A. By position of natural canines; also by space or not it is desired to make between incisors.

Q. What position should the six anterior teeth of upper jaw occupy.

A. Full width of jaw so as to partially conceal posterior teeth.

Q. How should posterior artificial teeth be placed as regards proximity.

A. Close together to prevent lodgement of food.

Q. When are thin anterior teeth required.

A. In close bites owing to occlusion of lower front teeth; also when jaws are small and tongue large.

Q. As regards Strength.

A. Select teeth that will not require so much grinding away as to endanger stability of their pins.

Q. In arranging artificial teeth should curve be outward or inward.

A. Outward curve.

Q. In arranging an entire set of upper and lower teeth, how should the bicuspids and molars be placed.

A. First upper bicuspids should articulate between 1st and 2nd lower bicuspids, so that each tooth meets two opposing teeth. Upper first bicuspids should be partly hidden by canines, and upper bicuspids and molars should slightly project over corresponding lower teeth; inner or palatal cusps should meet as well as outer cusps. The lower teeth should be placed well on alveolar ridge and not incline too much outward, and enough space be given to tongue.

Q. What teeth of an entire denture should be the longest

A. The lower to ensure greater stability.

Q. In grinding an entire denture, what teeth should be first arranged.

A. Lower incisors.

Q. The curves of arch in both jaws should be made by what teeth.

A. By six anterior teeth.

Q. The greatest pressure in masticating should be on what teeth.

A. Second bicuspids and first molars; hence second molars should be somewhat shorter.

Q. How outline Partial Lower Dentures containing Bicuspids and Molars.

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Q. The greatest pressure in masticating should be on what teeth.

A. Second bicuspids and first molars; hence second molars should be somewhat shorter.

Q. Should the lower teeth occupy an oblique or perpendicular position.

A. Perpendicular, as it is seldom necessary to incline them outward or inward; even when lower jaw projects somewhat, lower teeth should be perpendicular and upper teeth project outwards to meet them.

Q. What is the advantage of trying teeth in mouth after they are ground and temporarily arranged.

A. To determine articulation and expression; and to make any necessary changes.

VULCANITE.

Q. What change does dental vulcanite undergo when subjected to heat and pressure.

A. A molecular change known as "Vulcanization."

Q. What does this molecular change bring about.

A. Increase in hardness and specific gravity, and decrease in susceptibility to atmospheric influences.

Q. When does expansion and shrinkage occur during the vulcanizing of dental vulcanite.

A. As temperature rises the rubber expands; when vulcanizing heat is attained and temperature becomes stationary, the mass begins to solidify, and at such a stage gains in specific gravity and shrinks.

Q. What is the looseness a tooth standing alone on a partial denture due to.

A. The shrinkage of the rubber.

Q. How may this shrinkage be prevented, and no spaces left under teeth for putrefying food.

A. By packing in enough rubber to perfectly fill mould, and retaining enough to ensure a full mould at end of vulcanizing process.

Q. How may enough rubber be retained to ensure a full mould.

A. By interposing pieces of heavy tin-foil between the two halves of flask, so that it will not be fully closed; then, after the denture is about half vulcanized, remove flask, take out the pieces of tin foil and apply spring-pressure until the flask is completely closed; the second heating should immediately follow the first, to prevent the pressure from breaking down plaster model which soon disintegrates and softens.

Q. How thick should these tin foil pieces between flask be.

A. For upper dentures—No. 30; for very light cases=thinner; for heavy lower dentures—No. 24.

Q. How may sponginess or porosity be avoided in vulcanizing thick pieces of rubber.

A. By longer time to raise heat to vulcanizing point, and not raising it beyond a vulcanizing degree; also, by packing inside red rubber, pink rubber, weighted rubber, or pieces of old rubber plates, filed all over to secure clean surfaces; the more old rubber used the less will also be the shrinkage; the old should be completely covered by the new rubber to prevent difference of color.

Q. Is pure or adulterated rubber more liable to become porous.

A. The pure rubber.

Q. What is warping of old dentures due to when vulcarized a second time.

A. Contraction of the rubber.

Q. How may this contraction be remedied.

A. If a new denture, by warming the palatal edge enough to soften rubber, and bending it downwards to relieve the pressure on palatal surface at point causing irritation.

Q. If an old denture is so warped as to impair its fit, how may it be restored.

A. Widen it at condyles, by first directing light puffs of blow pipe flame on part back of central incisors until rubber is softened through for a space size of quarter of dollar; then seize denture by condyles with both hands, and pull them forcibly apart, and at same time dip denture in cold water.

Q. What is cracking of sectional blocks due to.

A. Either to excessive pressure in packing too much rubber; or attempting to close flask before enclosed rubber is well softened; or not allowing time for rubber to flow; or by contraction of rubber in cooling; or careless handling after removal from vulcanizer.

Q. Is rubber very sensitive to changes of temperature.

A. It is the most sensitive of any solid body.

Q. What causes chipping of edges of blocks.

A. If blocks are ground too much in rear so that only a narrow surface is left for contact at gum surface; or contraction, if rim of plate is thick and holds edges of gum.

Q. What will prevent this chipping.

A. Grind to square edges so that rubber will not have hold upon them; if either corner of edge is ground sharp, it should be the front, not the rear one.

Q. How should the waxing-up be done.

A. Wax should not overhang gums but be flush with gum, and surplus for finishing be secured by scraping off a little of the plaster after flasking and before packing.

Q. What should be the form of surface of denture immediately back of incisors.

A. Convex instead of concave, by filling in behind incisors in waxing-up, so that surface of plate will form an easy "reversed curve" beginning with palatal surfaces of incisors, and extending backwards nearly or quite half an inch over plate before normal thickness of plate is reached.

Q. What defect will such a contour of surface correct.

A. The whistling or whirring S sound caused by incorrect contour.

Q. How are partial "spring plates" of vulcanite made.

A. By scraping away a little plaster from palatal portion of bicuspids and molars upon the model, and in waxing-up allow wax to extend half an inch from teeth all around, the plate being so narrow that centre of palate is uncovered.

Q. What is the objection to such plates.

A. Tendency to force teeth outward.

Q. How may the form of a Vulcanite denture be changed.

A. By heating in oven with teeth downwards, or in boiling water, then placed on a new model of mouth, forced into position with a cloth, and held until cold.

Q. How remove teeth from a vulcanite denture.

A. Either passed through a flame until hot; immersed in oil and boiled; or covering denture with hot, dry sand.

Q. How reset a tooth or block with Amalgam.

A. Form a globular-shaped undercut in plate, grind tooth or block into place, and retain it while packing in amalgam.

Q. How reset a tooth or block with Woods' Fusible Metal.

A. Enlarge socket within, cut a dovetail in plate for anchorage; mold metal into socket with a heated spatula; heat tooth so that it will melt the metal, and then press it into place; protect thumb with cloth or chamois, and smooth the surface.

Q. How may a hole in plate be filled up.

A. Countersink on both sides, and make oblong or angular.

Q. How is liquid rubber made.

A. By cutting vulcanite into small pieces and immersing them in benzine, turpentine, chloroform, ether, or bisulphide of carbon; useful in uniting old to new rubber in vulcanizing.

Q. How may a small hole in a plate be closed.

A. By mixing gum shellac and vulcanite filings, heating them and dropping into hole, and afterwards smoothing with a hot spatula.

Q. How strong should Vulcanizers be made.

A. Strong enough to withstand a pressure three or four times as great as is required for vulcanizing.

Q. What Process gradually weakens and destroys Vulcanizers.

A. Corrosion, wholly upon sides of boiler, and at middle metal may waste away until scarcely thicker than paper.

Q. How can the weakness be determined.

A. Tapping boiler with a two ounce hammer; if metal is thick and strong, hammer will rebound from a light blow; if quite thin, the blow will sound dead as if made on lead and no rebound, and metal be dented and easily driven in.

Q. What is Corrosion the combined influence of.

A. Air and moisture.

Q. How may durability of vulcanizer be prolonged.

A. By expelling air before vulcanizing, and keeping boiler dry and clean when not in use.

Q. What powders are best for the packing to ensure easy separation of lid from boiler.

A. Black lead, soapstone; but a small quantity of either, otherwise it will become porous or scale off; oil will become gummy and dry and hold the lid tighter.

Q. Why should sufficient steam room always be left in boiler.

A. If filled with water and no room left for expansion, a pressure will be developed much greater than that due to production of steam.

Q. Is water elastic or inelastic.

A. Inelastic.

Q. What is the pressure per square inch in lbs. of steam at 320° F.

A. 75 lbs.

Q. What at 350° F.

A. 120 lbs; and at 400° F., it is 235 lbs.; and at 500°, it is 661 lbs.

Q. What is the effect when water closely confined is heated.

A. Its expansion generates a force practically irresistible.

Q. If vulcanizer is filled with water, how great may be the pressure to the inch without heating water to boiling point.

A. 1,000 lbs.

Q. How are thermometers set to ensure durability.

A. In a mercury bath.

Q. Should soft vulcanized rubber turn color and become harsh, what will restore it.

A. Boiling it for five minutes in a solution of one ounce of common soda to pint of water, and afterwards washing in clean water.

Q. Why are vulcanite dentures sometimes lined with gold.

A. To prevent contact of rubber with mouth.

Q. How is the gold applied.

A. Either in one piece of heavy foil; or in a number of pieces, each overlapping the other, the rubber being first packed and gold applied to surface of model and closely adapted.

Q. How may *Black Rubber* be vulcanized.

A. By using pure black rubber, and dry process; no steam allowed to enter packing chamber of New Mode Heater during process; the time required is five hours at 320° F.

Q. How may *Red Rubber* be vulcanized in New Mode Heater.

A. The flask is heated and packed in oven, the apparatus closed; the screws covered with the caps to make them steam tight; the steam valve raised to admit steam to packing chamber : raise heat to 320° F., and allow case to remain in hot box at such temperature for one and a half hours.

CELLULOID.

Q. What is the composition of *Dental Celluloid.*

A.

Pyroxylin (gun cotton)	100 parts.
Camphor	40 "
Oxide of Zinc	2 "
Vermillion	0.6 "

Q. What is the strength of celluloid compared with that of Vulcanite.

A. Celluloid is stronger than Vulcanite.

Q. What has been suggested to remove the camphor odor.

A. Placing set in solution of sulphuric acid, one part, water, two parts, for four or five hours.

Q. What are the advantages of celluloid over vulcanite.

A. A more natural gum color, and greater strength.

Q. What are the disadvantages of Celluloid.

A. If great care is not exercised in its moulding, change of shape; also discoloration and porosity, if the hard outer surface (such as the moulding between metallic surfaces gives) is removed in the finishing process.

Q. What is the principal solvent of celluloid.

A. Spirits of camphor.

Q. How is the celluloid prevented from adhering to plaster surface of model.

A. By coating such surface with liquid silex, collodion, or oil. The use of a block-tin or bronze metal cast, or tin foil over plaster, prevents adhesion and gives a harder outer surface to the celluloid plate.

Q. To secure the best practical results how should Celluloid be worked.

A. It should be moulded or pressed into form at the highest possible temperature that will not burn it; time given it to soften in screwing down flask, and the temperature of piece at once reduced when moulding is completed, and kept under pressure until cold.

Q. What quality of Plaster of Paris should be used.

A. A good quality of builder's plaster, which has the requisite strength, not the fine and highly calcined.

Q. What are the three modes of moulding Celluloid.

A. With steam, glycerine or oil, and by dry heat; the latter being the best.

Q. The manipulations are similar to those of what other work, until flasking.

A. Vulcanite.

Q. How should the Plaster be mixed.

A. Not too thin, and free from air-bubbles, adding the plaster to the water and allowing it to absorb all it will take up, making it as thick as can be poured.

Q. Is it admissible to use salt, or sulphate of potash in the plaster.

A. No, they lessen the strength; if rapid setting is desirable, tepid water may be used without injury.

Q. What are Celluloid Blanks.

A. Prepared plates resembling the mouth in form and size, different series of which are made to select from—full upper and lower, and partial.

Q. How should the "flasking" for celluloid be done.

A. Mix the plaster as thick as it can be well poured, stir thoroughly and pour some into the flask (or impression when obtaining model), and shake down well. Then add more plaster to the batter remaining in bowl, until the mass is thick enough to build up; fill flask with this, and shake down thoroughly and solidly; so fill flask that it may be parted at the edge of the wax base plate.

Q. What form of Blank should be selected for the case on hand.

A. One as near size of model as possible, not so wide as to permit of folding in from sides and thus form creases; just large enough to have an excess in every part.

Q. What is the base-plate composed of.

A. Thin paraffine, on which the vulcanite teeth are mounted in accordance with the articulation.

Q. What is the manipulation from this point according to the "Seabury Process.

A. The fullness of gum, the festoons and undulations of the same are carried out as if the case were ready for flasking, when a plaster matrix is made over labial surface of gum and tooth, which matrix is divided at the centre and the two halves taken off. The paraffine is chilled in cold water, dried, and each tooth is warmed and carefully removed from base plate. When all the teeth are taken off, the places they occupied are filled by dropping a small quantity of melted wax in each place so as to allow for a slight surplus. The case is then flasked without the teeth, and in separating sections of flask all the paraffine base plate is preserved; a celluloid blank is moulded between the plaster sections; the paraffine base plate is again returned to model (a metallic die is better than a plaster model), the teeth returned to their former places, and the case again waxed up as it was before. Thick tin foil (No. 60) is

accurately burnished over gum surface and teeth, and stippled with a serrated plugger in imitation of gum; the edges of the tin foil beyond the edge of gum, are clipped with scissors and bent at right angles to gum surface; the case is flasked and ready for moulding.

Q. How may celluloid blanks be changed in form and made smaller before moulding.

A. By softening in boiling water and pressing into any shape, and trimming off excess with a sharp knife.

Q. After separating the sections of flask what is to be done.

A. Remove the base-plate of wax or paraffine by boiling water, and rub powdered soapstone over surface of model to prevent plaster from adhering to celluloid.

Q. How is the excess of celluloid provided for.

A. By cutting a groove in the investment plaster of the section of flask containing the model, not less than one eighth of an inch from it.

Q. How is the excess better provided for in case gum teeth are used.

A. By trimming the plaster all around between model and edge of flask to about the thirty second of an inch, and holes drilled in plaster opposite to each joint of the teeth of one-eighth inch in diameter, to relieve the blocks from as much pressure as possible.

Q. How is Celluloid moulded by steam.

A. Fill boiler partly full of water, at least enough to cover ribs at bottom. Have screws well turned back, until plunger, when in position, will rest against top of boiler. Turn down cover securely; see that the gland is turned back and that screw works freely. Let the sense of feeling be best guide as to how hard to screw. After placing flasks in position, turn down screw very gently with thumb and finger until it is felt to touch flask. Fill cup with alcohol and light it, or light gas; the valve will now blow off steam at 225° F. Until this occurs nothing else is to be done. As soon as steam escapes at valve, with upper portion suspended, the blank will soften and the screw be felt to yield to light pressure with thumb and finger. The upper weight should now be dropped down; then turn screw very carefully, stopping when resistance is felt to increase; as soon as it yields, turn again, and follow up pressure as the heat rises and screw yields; then increase pressure allowing time between the turns of screw; at the close of process the pressure should be considerable, all that can be made by screw. If operation is properly timed, the steam will blow off at time moulding is completed, and alcohol in lamp consumed; if other heat is used, such as gas, the flame should be sufficient to complete process in thirty to forty minutes, not longer.

Q. How is Celluloid molded in Glycerine.

A. Same method until flask is ready to be placed in tank; place blank in flask, put in screw-clamp and turn down screw until it touches flask lightly; put all into tank, and pour enough glycerine in tank until it comes up to top of flask; one and a half pounds of glycerine will suffice. Then apply heat, and as soon as blank softens the screw will yield to gentle pressure, (at 225° F); turn screw very lightly at first, continuing as the celluloid is felt to yield, and increase to heavy pressure as the flask is closed. The heat should never rise above 280° F. Lard or oil may be used instead of glycerine, but latter is more cleanly.

Q. How may a celluloid case be cooled.

A. As soon as screw is down, put out flame and blow off steam, and allow flask to become thoroughly cold before opening and removing set; the cooling of flask can be hastened by cold water without injury, but case must be kept in flask-clamp until cold.

Q. What precaution should be taken if celluloid is of extra thickness, or where shape of blank has been greatly changed.

A. The flask containing it should be placed over register or near stove for half a day or more at a temperature of not over 140° F.

Q. May Celluloid be molded with safety in "New-Mode Heater" at a greater temperature than in any other apparatus.

A. Yes; as high as 310° or even 320° F., and to give better results against subsequent warping of plate.

Q. What is the dry-heat method in using the "New mode Heater."

A. Dry the investment either by raising temperature to 320° F., keeping hot box dry, or by admitting steam to hot box; if steam is up, either method may be employed; then remove flask from chamber, adjust blank, replace flask in oven immediately under screws; open screw cap a turn or two to allow gas to escape from hot box; turn down large screw until it bears lightly on top of flask; close machine; and in five minutes molding may be commenced. First turn screws with thumb and finger, and when blank is properly softened use the smaller key-wrench; close flask gradually, stopping whenever resistance is too great. If temperature is 300° F., flask can be closed in 10 minutes; if blank is very thick mold more slowly, about 30 minutes. As soon as flask is closed, put out flame, open door, and allow machine to cool; if a lock-flask is used, it may be removed and thoroughly cooled before opening machine, which is then ready for another set.

Q. How is a Celluloid set finished.

A. By use of sand paper, and scrapers; polished with pumice and water, finally using whiting or prepared chalk on a soft brush-wheel at high speed; or by rubbing with a soft cloth wet with camphor.

Q. What precaution may be taken to keep celluloid blank clean.

A. Clean hands, and wrapping flask in muslin cloth when molding.

Q. What is the cause of porous celluloid plates.

A. Overheating, and want of pressure at proper time.

Q. What causes the dark lines on celluloid plates.

A. Using a blank too wide, or one too thin in centre, causing celluloid to press inward as well as outward and fold upon itself; or beginning the pressure too soon which tears blank.

Q. How may the natural gum be imitated.

A. By using tin foil over palatal and outer gum surfaces and "stippling" it, which is done by dotting the surface with a dull pointed instrument or serrated plugger.

Q. How are cases of deep undercuts managed so as to avoid breaking plaster model.

A. By so investing model in flask that the pressure in molding is brought to bear upon the mass of plaster supporting projection; in other words by elevating front surface of model where projection is located.

Q. How may we add to or repair a broken celluloid plate.

A. By perfectly cleaning surfaces to be united, forming dovetails on each side of crack or space in old plate, and moistening the edges with liquid cellu-

loid or spirits of camphor, and molding a piece of celluloid into crack or space.

Q. How may a broken tooth be replaced.

A. By removing all of broken tooth without disturbing outline of socket, heat a large burnisher in boiling water and enlarge the hole; insert the new tooth; pour plaster over face of tooth to secure it, and cover bulge made in celluloid by enlarging the hole for new tooth, with heavy tin foil. Heat an instrument in hot water and force the celluloid firmly about pins of tooth; drop cold water on it while holding the hot instrument against it. Another method is to proceed as just described up to point of using hot instrument, then fasten tooth with adhesive wax and invest in flask; after separating the sections, remove wax and place a small piece of celluloid over inner surface of tooth, and mold in heater.

Q. How may a tooth be removed from a celluloid set.

A. Hold outside surface of tooth in flame of an alcohol lamp until heat softens celluloid around pins of tooth.

Q. How may a continuous gum of celluloid be attached to a vulcanite plate.

A. Use continuous gum teeth (or those with long necks), set them up in wax in usual manner, leaving outside of roots exposed; place a softened thin strip of wax to portion of wax plate representing gum; finish palatal surface, and invest in flask; remove wax, pack with rubber and vulcanize; remove from flask when rubber plate will present a vacancy to be filled with celluloid at portion representing outer surface of gum; fill this vacancy or space with paraffine and wax by melting and dropping it in, and carve it into desired form of gum; then invest in one section of flask with teeth upward and raised in such a manner that the upper section of flask may be removed without dragging; imbed in plaster to rim, pouring it over palatal surface, covering crowns and filling interstices between necks of teeth, but leaving their outer surfaces exposed; then after it has set, pour more plaster around inner edge of flask section forming a ridge, leaving a groove between it and plate; finish investing, and remove wax away from groove and teeth with boiling water. Select a proper blank, and saw off its outer rim, which is softened in boiling water, and with a cloth pressed closely about teeth and held in place until it has hardened; join the two sections of flask and place in oven of "New Mode Heater," and when temperature of 280° F. is reached the flask is closed.

Q. What advantages have metal casts or models over plaster models.

A. Better results are obtained by molding either vulcanite or celluloid upon metal, no danger of fracture, and palatal surface of plate comes out with a hard polish.

Q. How is this metal model or cast obtained.

A. The same as a zinc die for swaging; composed of block tin or fusible metal.

Q. How may it be formed so as to render its removal from hardened celluloid plate easy.

A. By pouring metal into a sand model, and allowing it to remain only long enough to cool on outside; then, turning it over, letting all the metal remaining molten run out, and thus obtaining a thin shell which is cut all round ridge with a fine saw leaving only enough connection to hold parts together; plaster is poured into this hollow shell and the model completed. To remove it from hardened plate, the edges are crushed in between a vise. Another method is to form a plaster core of cross shape, and sinking this into the

molten metal of the cast before it has cooled, thus dividing the cast into four sections which may be crushed together in a vise.

Q. How are metallic clasps and backings attached to vulcanite and celluloid plates.

A. By having the ends, or, in case of clasps, the additions, extend into the wax base-plate, supported by the plaster, after these ends are bent at more or less of a right angle to surface of cast or model; the vulcanite (or celluloid) is packed under and over these extensions.

Q. How is liquid celluloid made.

A. By dissolving pieces of celluloid in spirits of camphor.

END OF PART II.